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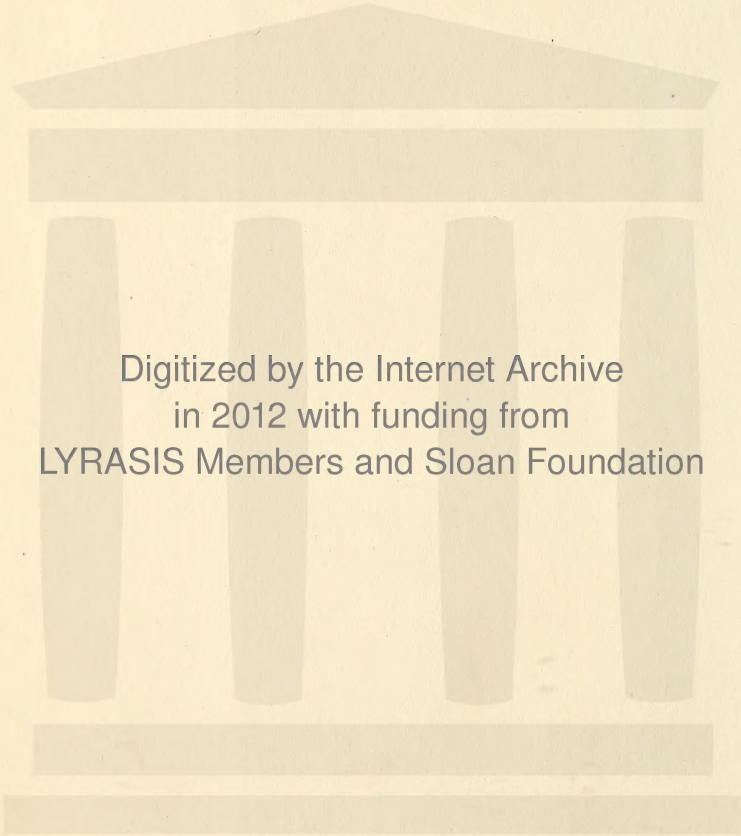
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The Pennsylvania State College Bulletin

ANNOUNCEMENT OF THE GRADUATE SCHOOL

1948 - 49

PENN STATE COLLECTION

The Pennsylvania State College Bulletin

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1948-49

State College, Pennsylvania

STATE COLLECTION

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STATE COLLEGE, PENNSYLVANIA

COLLEGE CALENDAR

1947-1948

(As applicable to the Graduate School)

1948

Second Semester 1947-1948

Feb. 6-7, Fri.-Sat.	Second Semester Registration
Feb. 9, Mon.	Second Semester Classes begin, 8 a.m.
Mar. 25, Thurs.	Spring Recess begins, 11:50 a.m.
Mar. 31, Wed.	Spring Recess ends, 8 a.m.
May 30, Fri.	Memorial Day Recess
June 3, Thurs.	Second Semester ends, 5 p.m.
June 7, Mon.	Second Semester Graduation Exercises

Summer Program 1948

June 8, Tues.	Inter-Session begins
June 25, Fri.	Inter-Session ends, 5:50 p.m.
June 28, Mon.	Registration for First 6-weeks Session
June 29, Tues.	Summer Session Classes begin, 8 a.m.
July 5, Mon.	Independence Day Recess
Aug. 7, Sat.	End of First 6-weeks Term, 12:20 p.m.
Aug. 9, Mon.	Registration for Second 6-weeks Term
Aug. 27, Fri.	Post-Session ends, 5:50 p.m.
Sept. 6, Mon.	Labor Day Recess
Sept. 18, Sat.	Summer Program ends, 12:20 p.m.

First Semester 1948-1949

Sept. 24-25, Fri.-Sat.	First Semester Registration
Sept. 27, Mon.	First Semester Classes begin, 8 a.m.
Nov. 24, Wed.	Thanksgiving Recess begins, 11:50 a.m.
Nov. 29, Mon.	Thanksgiving Recess ends, 8 a.m.
Dec. 18, Sat.	Christmas Recess begins, 11:50 a.m.

1949

Jan. 3, Mon.	Christmas Recess ends, 8 a.m.
Jan. 31, Mon.	First Semester Graduation Exercises

Second Semester 1948-1949

Feb. 4-5, Fri.-Sat.	Second Semester Registration
Feb. 7, Mon.	Second Semester Classes begin, 8 a.m.
Apr. 14, Thurs.	Spring Recess begins, 11:50 a.m.
Apr. 20, Wed.	Spring Recess ends, 8 a.m.
June 1, Wed.	Second Semester ends, 5 p.m.
June 6, Mon.	Second Semester Graduation Exercises

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ARNOLD JOHN CURRIER, M.S., Ph.D., *Associate Professor of Chemistry*
HENRY MAUZEE DAVIS, M.S., Ph.D., *Associate Professor of Metallurgy*
RALPH B. DAY, M.E., *Associate Professor of Mechanical Engineering*
LESLIE E. DILLS, M.S., Ph.D., *Associate Professor of Economic Entomology*
ELISABETH W. W. DYE, M.A., *Associate Professor of Home Economics*
PAUL EBAUGH, A.B., *Associate Professor of Engineering Research*
CHARLES AUSTIN EDER, M.S., *Associate Professor of Civil Engineering*
DORIS E. EKSTROM, B.S., M.S., Ph.D., *Associate Professor of Home Economics Education*
GEORGE H. FLEMING, M.S., Ph.D., *Associate Professor of Chemistry*
HAROLD KENNETH FLEMING, M.S., *Associate Professor of Pomology*
ALLEN HARRIS FORBES, Ph.B., E.E., *Associate Professor of Electrical Engineering*
HELEN SAVARD GALBRAITH, M.A., *Associate Professor of Applied Arts*
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DAVID J. GILDEA, M.S., *Associate Professor of Aeronautical Engineering*
WILLIAM HENRY GRAY, M.A., Ph.D., *Associate Professor of Latin-American History*
BEATRICE LIBERTY HAGEN, M.A., Ph.D., *Associate Professor of Mathematics*
FRANCIS TOBEY HALL JR., M.S., *Associate Professor of Electrical Engineering*
WILLIAM M. HENCH, M.A., Ph.D., *Associate Professor of Economics*
MERLIN T. HENDERSON, M.S., Ph.D., *Associate Professor of Agronomy*
GEORGE WILLIAM HENNINGER, M.A., *Associate Professor of Music*
CLIFFORD B. HOLT JR., M.S., *Associate Professor of Electrical Engineering*
MERWIN W. HUMPHREY, M.F., *Associate Professor of Forestry*
ALBERT WITT HUTCHISON, M.S., Ph.D., *Associate Professor of Chemistry*
EVAN JOHNSON JR., M.A., Ph.D., *Associate Professor of Mathematics*
PAUL BOYD KAPP, B.S., *Associate Professor of Engineering Mechanics*
PAUL M. KENDIG, M.S., Ph.D., *Associate Professor of Engineering Research*
PHILIP SHRIVER KLEIN, M.A., Ph.D., *Associate Professor of American History*
HENRY WILLIAM KNERR, M.A., Ph.D., *Associate Professor of Physics*
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DAVID A. KRIBS, M.S., Ph.D., *Associate Professor of Botany*
WILLIAM MORTON LEPLEY, M.A., Ph.D., *Associate Professor of Psychology*
ANNA PAULINE LOCKLIN, M.A., *Associate Professor of English Literature*
JOHN CAMPBELL MAJOR, M.A., Ph.D., *Associate Professor of English Composition*
THOMAS WILLIAM MASON, M.S., *Associate Professor of Analytical Chemistry*
EUGENE T. MCDONALD, M.Ed., D.Ed., *Associate Professor of Clinical Speech and Speech Education; Director of the Speech and Hearing Clinic*
MARION S. MCDOWELL, M.A., *Associate Professor of Home Economics*
M. NELSON MCGEARY, M.A., Ph.D., *Associate Professor of Political Science*
ROBERT PETER MEAHL, M.S., *Associate Professor of Ornamental Horticulture*
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LAYMON N. MILLER, M.A., *Associate Professor of Engineering Research*
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GEORGE FREDERICK MITCH, M.A., *Associate Professor of Economics*
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WILLIAM M. MYERS, M.S., Ph.D., *Associate Professor of Mineral Economics*
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THOMAS SAYLOR OAKWOOD, M.S., Ph.D., *Associate Professor of Organic Chemistry*
GILMA OLSON, M.S., *Associate Professor of Home Economics*
LOUIS FRANCIS PECK, M.A., Ph.D., *Associate Professor of English Composition*
SYLVAIN JOSEPH PIRSON, E.M., C.E., M.S., D.Sc., *Associate Professor of Geophysics and Geochemistry*
ALBERT PERRY POWELL, M.S., *Associate Professor of Electrical Engineering*
GORDON H. PRITHAM, Ph.D., *Associate Professor of Physiological Chemistry*
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A. CHESTER RICHER, M.S., Ph.D., *Associate Professor of Soil Technology*
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ARTHUR ROSE, M.A., Ph.D., *Associate Professor of Chemical Engineering*
URWIN ROWNTREE, B.S., *Associate Professor of Industrial Education*
JOSEPH JAY RUBIN, M.A., Ph.D., *Associate Professor of English Composition*
CLAYTON H. SCHUG, M.A., *Associate Professor of Public Speaking*
RALPH PRAY SEWARD, M.A., Ph.D., *Associate Professor of Chemistry*
F. RAYMOND SMITH, M.A., Ph.D., *Associate Professor of Physics*
WILLIAM M. SMITH JR., M.S., Ph.D., *Associate Professor of Home Economics*
WILLIAM U. SNYDER, M.A., Ph.D., *Associate Professor of Psychology*
HARRY A. SORENSEN, M.S., Ph.D., *Associate Professor of Mechanical Engineering*
JOSEPH E. SPAGNUOLO, M.S., *Associate Professor of Architectural Engineering*
CHARLES MARTIN SPEIDEL, M.S., *Associate Professor of Physical Education*
HERBERT STEINER, Ph.D., *Associate Professor of German*
J. KENNETH STERN, M.S., *Associate Professor of Agricultural Co-operation*
ARTHUR BRUCE SUTHERLAND, M.A., Ph.D., *Associate Professor of English Literature*
FLORENCE E. TAYLOR, M.A., D.Ed., *Associate Professor of Elementary Education* (part-time)
WILLA WILLIAMMEE TAYLOR, M.A., *Associate Professor of Music Education*
GLENN NICHOLAS THIEL, M.Ed., *Associate Professor of Physical Education*
EDWARD BUNN VANORMER, M.A., Ph.D., *Associate Professor of Psychology*
ROBERT KING VIERCK, M.S., *Associate Professor of Engineering Mechanics*
HERBERT ALEXANDER WAHL, M.S., Ph.D., *Associate Professor of Botany*

JOHN B. WASHKO, M.S., Ph.D., *Associate Professor of Agronomy*
RICHARD HADLY WATERS, M.A., Ph.D., *Associate Professor of Economics*
WAYNE WEBB, M.S., Ph.D., *Associate Professor of Physics*
ROBERT L. WEBER, M.A., Ph.D., *Associate Professor of Physics*
CLIFFORD CHARLES WERNHAM, M.A., Ph.D., *Associate Professor of Plant Pathology*
MABEL ELIZABETH WESTGATE, M.A., *Associate Professor of Home Economics*
DELPHA E. WIESENDANGER, B.A., M.S., *Associate Professor of Home Economics*
MARY LOUISA WILLARD, M.S., Ph.D., *Associate Professor of Chemistry*

ASSISTANT PROFESSORS

HELEN ADOLF, Ph.D., *Assistant Professor of German*
PAUL MARCKS ALTHOUSE, M.S., Ph.D., *Assistant Professor of Agricultural and Biological Chemistry*
CLIFTON A. ANDERSON, B.S., B.A., M.S., *Assistant Professor of Industrial Engineering*
THOMAS FULCHER BATES, M.A., Ph.D., *Assistant Professor of Mineralogy*
DOUGLAS STEWART BROWN, A.M., *Assistant Professor of Economics*
JOHN DONALD CLENDENIN, M.S., *Assistant Professor of Fuel Technology*
JOHN BAPTIST CLOPPET, Ph.D., *Assistant Professor of Romance Languages*
RAY M. CONGER, M.S., *Assistant Professor of Physical Education*
NEWELL C. COOK, M.S., Ph.D., *Assistant Professor of Chemistry*
GILBERT LEROY CROSSLEY, B.S., E.E., *Assistant Professor of Electrical Engineering*
CHARLES G. DODD, M.S., Ph.D., *Assistant Professor of Ceramics*
SYBIL D. EMERSON, B.A., B.S., *Assistant Professor of Home Economics and Art Education*
KENT FORSTER, M.A., Ph.D., *Assistant Professor of History*
RICHARD B. FOX, M.S., *Assistant Professor of Architectural Engineering*
FRANK BURT FREIDEL JR., M.A., Ph.D., *Assistant Professor of American History*
JOHN C. GRIFFITHS, M.S., Ph.D., D.I.C., *Assistant Professor of Mineralogy*
ALVIN R. GROVE, M.S., Ph.D., *Assistant Professor of Botany*
LESTER PHILIP GUEST, MA., Ph.D., *Assistant Professor of Psychology*
JOHN ROBERT HAYES, M.S., Ph.D., *Assistant Professor of Chemistry*
ROBERT V. HIGDON, B.S., M.S., *Assistant Professor of Electrical Engineering*
FRANCIS EDWIN HYSLOP JR., M.A., M.F.A., *Assistant Professor of Fine Arts*
HENRY JANZEN, M.A., Ph.D., *Assistant Professor of Political Science*
ELTON WRIGHT JONES, M.S., *Assistant Professor of Electrical Engineering*
EUGENE P. KLIER, M.S., Ph.D., *Assistant Professor of Metallurgy*
ERNEST A. LACHNER, Ph.D., *Assistant Professor of Fisheries Biology*
JOSEPH THADDEUS LAW, M.A., *Assistant Professor of Political Science*
WAYNE A. LEE, M.S., Ph.D., *Assistant Professor of Marketing*
L. LARRY LEONARD, M.A., Ph.D., *Assistant Professor of Political Science*
ROBERT W. LINDSAY, M.S., D.Sc., *Assistant Professor of Metallurgy*
MILDRED ADAMS LUCEY, M.S., *Assistant Professor of Physical Education*
DAVID H. MCKINLEY, M.A., LL.B., *Assistant Professor of Economics*
WILFORD RICHARD MILLS, Ph.D., *Assistant Professor of Plant Pathology*
MARGARET A. NEUBER, M.A., *Assistant Professor of Elementary Education*
AMOS EARL NEYHART, M.S., *Administrative Head, Institute of Public Safety, Informal Instruction Division, Extension Services*
RALPH FRANK NIELSEN, M.S., Ph.D., *Assistant Professor of Petroleum and Natural Gas Engineering*
CLARENCE IRWIN NOLL, M.S., Ph.D., *Assistant Professor of Chemistry*

Ruth L. Pike, M.A., *Assistant Professor of Home Economics*
Theodore Stephen Polansky, M.S., Ph.D., *Assistant Professor of Fuel Technology*
Margaret C. Raabe, M.S., *Assistant Professor of Clinical Speech*
Richard Collyer Raymond, Ph.D., *Assistant Professor of Physics*
Donald Ross, M.S., *Assistant Professor of Engineering Research*
Roger B. Saylor, A.M., *Assistant Professor of Economics*
Robert W. Schiessler, M.S., Ph.D., *Assistant Professor of Chemistry*
Leo Sommer, M.S., Ph.D., *Assistant Professor of Chemistry*
Randall S. Stout, M.B.A., Ph.D., *Assistant Professor of Economics*
Shiou-Chuan Sun, M.S., Sc.D., *Assistant Professor of Mineral Preparation*
Abram VanderMeer, M.A., Ph.D., *Assistant Professor of Education*
David Van Meter, M.S., *Assistant Professor of Electrical Engineering*
Romeo Barrick Wagner, M.S., Ph.D., *Assistant Professor of Chemistry*
Alfred Frederick Woelfel, M.S., *Assistant Professor of Electrical Engineering*
Guy Woods, M.A., *Assistant Professor of Music*
C. Courson Zeliff, M.S., Ph.D., *Assistant Professor of Zoology*
Harry D. Zook, M.S., Ph.D,, *Assistant Professor of Chemistry*

INSTRUCTORS

Frances M. Andrews, M.Ed., *Instructor in Music Education*
James D. Lemley, M.S., *Instructor in Human Nutrition Research*
H. David Rix, Ph.D., *Instructor in Physics*
Kenneth W. Smith, M.S., *Instructor in Petroleum and Natural Gas Engineering*

THE GRADUATE SCHOOL

THE GRADUATE SCHOOL of The Pennsylvania State College was established in 1922. Graduate instruction had been given previously under the direction of a committee of the faculty or of the College Senate. The Graduate School has general control of all questions that pertain to the interests of graduate work. The faculty consists of such members of the instructional staff as have immediate supervision of graduate courses.

In the Graduate School it is the intention to reduce routine requirements to a minimum. So far as they exist they are for the purpose of furnishing the discipline and methods necessary for independent study and investigation. It is the object of the Graduate School to surround the student with conditions that will enable him to devote himself to some chosen field. Courses of study, association with older investigators, and other aids and directions are for the promotion of independent and productive scholarship. Advanced degrees are conferred as a mark of attainment of certain standards of scholarship.

The President of The Pennsylvania State College, on recommendation of the Dean of the Graduate School, will welcome Doctors of Philosophy of The Pennsylvania State College, as well as of other accredited colleges and universities, as guests of The Pennsylvania State College, with the privilege of attending seminars and research courses and of carrying on research in the laboratories and libraries. There will be no charge except for laboratory expenses. Arrangements should be made in advance with the Dean of the Graduate School.

ADVANCED DEGREES.—The advanced degrees conferred by this College are of three classes: (a) the academic degrees—Master of Arts, Master of Science, and Doctor of Philosophy; (b) the professional degrees—Master of Education and Doctor of Education, Master of Forestry, and (c) the technical degrees—Architectural Engineer, Chemical Engineer, Civil Engineer, Mechanical Engineer, Industrial Engineer, Electrical Engineer, Ceramic Engineer, Metallurgical Engineer, Engineer of Mines, and Petroleum Engineer.

ADMISSION.—To be admitted to the Graduate School an applicant must have received a baccalaureate degree from an accredited institution, earned under residence and credit conditions substantially equivalent to those required by The Pennsylvania State College.

For admission to the Graduate School, graduates of The Pennsylvania State College must have a minimum grade point average of 1.5 in their junior and senior years. Graduates of other institutions with different systems of grading must present equivalent standing. A student applying for admission, after having attended another graduate school where a substantial amount of credit has been earned, or a student whose career subsequent to graduation has been characterized by unusual attainments in fields having a bearing on his graduate qualifications, will be rated by a combination of the records submitted.

Admission is granted by the College Examiner. If the applicant has attended more than one institution, an official transcript of the work covered at *each* institution is required. This applies to the complete academic record, both *undergraduate* and *graduate*. Graduates of The Pennsylvania State College may present their final grade report or an official transcript of their complete record at The Pennsylvania State College at the time of their application for admission to the Graduate School here. For the convenience

of graduates of teachers colleges special forms covering the undergraduate record have been prepared and should be obtained from the Examiner. Because of the rule requiring a 1.5 average or higher during the junior and senior years of work, each applicant for admission should make every effort to have *complete* credentials in the hands of the College Examiner before the session opens in which he intends to enroll. *Official credentials should be sent directly from institutions to the Examiner.* Failure to give attention to these important matters *in advance* can lead only to delay in registration. If credentials are *not sent in advance* or are *not available at registration* this does not necessarily mean that the application for admission will be refused, but certification of credits will be withheld until the admission status has been determined.

Prospective students may make inquiries at any time regarding the possibilities of graduate study. Questions pertaining to admission should be addressed to the College Examiner. Blanks to be used in making application for admission are obtained from the Examiner. Attention is called to the fact that there are instructions on these blanks which explain in further detail the procedures of admission. General inquiries regarding graduate work may be addressed to the Dean of the Graduate School. Students should not hesitate to write directly to the head of a department if they have specific questions regarding the work of a department.

CLASSIFICATION.—At the time of admission all candidates must enroll either as *Regular* or as *General* graduate students. The difference between the two groups is as follows:

Regular Graduate Students (degree candidates).—This group includes all those desiring to become candidates for degrees at The Pennsylvania State College. Their complete status is determined and conditions of candidacy arranged. A program is developed under the guidance of an adviser. There is a matriculation fee of $5 which should accompany the application for admission.

Students desiring to go forward as candidates for degrees will do well to enroll at once as regular graduate students.

General Graduate Students (nondegree candidates).—Applicants who meet all requirements for admission to the Graduate School, but who have not decided to become candidates for an advanced degree at this institution, may arrange for a program of work as general graduate students. This classification is open to those desiring to transfer credit to another institution or to those wishing to follow a certain program for the fulfillment of requirements other than those of advanced degrees. There is an *admission fee* of $1 which should accompany the application for admission.

If a student once enrolled as a general graduate student desires to become a regular graduate student, i.e., a candidate for an advanced degree, he may do so by making the necessary application to the College Examiner and by paying the $5 matriculation fee.

Not more than six credits earned as a general graduate student may be used toward the requirements for a degree.

REGISTRATION.—All students must register at the beginning of each semester or summer term. The registration days are indicated in the College Calendar on page 3. Graduate students are allowed one week for registration following the regular registration days before the late fee of $5 is imposed. *Registration must be completed within two weeks.* These regulations apply to the academic year. *There are different regulations applicable to the summer sessions which are included in the summer sessions announcements.*

The student must prepare each term a program satisfactory to the major department or group committee. When this schedule is approved by the Dean of the Graduate School the student shall present himself at the office of the Registrar and shall fill out such blanks as may be required.

The payment of the required fees at the Bursar's office completes the registration.

Under certain conditions credit may be earned by work done off the campus. Students contemplating such work should inquire of the Dean of the Graduate School about the plans and conditions. Such work must be scheduled in advance in the regular manner.

CHANGES IN THE PROGRAM.—When changes in program of a graduate student are advisable they may be made with the approval of the Dean on "change of schedule" blanks. Carefully planned schedules should obviate many changes. *Necessary changes should be made promptly. In the summer sessions a delay may make changes impossible.* The foregoing statements refer to changes in specific courses. If, however, the student should decide to make a change in his major or in the degree toward which he is working, he would be required to make such change through the Office of the College Examiner and his status in respect to the new major and the degree would be determined by the Examiner at that time. A fee of $1 is charged for each change of schedule except when the change is necessitated by the College.

CREDITS AND GRADES.—Instructors will report in duplicate all grades for graduate students, one report to the Dean of the Graduate School, one to the Registrar. Courses bearing a number in the 500 series are marked on the basis of P ((pass), H (honors), F (fail). For work taken in the 400 series a passing grade of 2 is required.

GRADUATE SCHOOL FEES

Matriculation fee (regular students)	$ 5.00
Admission fee (general students)	1.00
Incidental fee, each semester	50.00
General Course fee, each semester	20.00
Health service fee, each semester	7.50
Library fee, each semester	2.50
Off campus registration fee, each year	2.50
Graduation fee	10.00
Transcript of record (extra copy)	1.00
Change of schedule fee	1.00
Part-time fee, per credit (for not less than 12 credits)	8.00

Laboratory fees and deposits, according to schedule.

Summer session students who register for graduate courses pay the regular fees for the summer sessions.

In addition to the above fees, all students who are not residents of Pennsylvania are charged a tuition fee of $75 per semester. There is no exemption from this fee.

Whenever it shall appear from any of the data presented as part of the application for admission that the applicant is not a resident of Pennsylvania, the College Examiner, when admission is granted to that applicant, assumes that the one admitted is a non-Pennsylvanian. A student so admitted is held liable for the out-of-State tuition fee.

If the one who is admitted believes that his circumstances do not justify his classification as a non-Pennsylvanian, he may petition the Bursar of the College for reclassification.

Whenever such a petition for reclassification is made, the petitioner is required to present proof of bona fide continuous residence of the one admitted (or his parents, if he is a minor) within the Commonwealth for a period of not less than 12 months immediately preceding his admission; and, in addition, such other evidence as may appear pertinent to a complete review of the classification.

CANDIDACY FOR ACADEMIC AND PROFESSIONAL DEGREES

In order to be admitted to candidacy for an advanced degree the applicant must meet in full (1) the requirements for admission to the Graduate School, (2) certain undergraduate preparation necessary for the particular major chosen, and (3) must present a program approved by the major department.

ACADEMIC DEGREES

PREREQUISITE FOR CANDIDACY.—Ample undergraduate preparation in the field in which the candidate intends to carry on graduate work is required. The amount of preparation cannot be stated in credits as it varies in the different departments. Full information as to what is considered adequate in the various fields and departments is on file in the office of the College Examiner. Graduate students are told at the time of their admission whether they meet the requirements for candidacy for the degree sought. Applicants who are somewhat deficient in preparation may under certain conditions be admitted to the Graduate School but not to candidacy for a degree until satisfying the requirements outlined to cover their particular case. This does not apply to a deficiency in the 1.5 scholastic average. If there is a deficiency in this regard applicants will be refused admission to the Graduate School until they have brought up their standing by further undergraduate work. Applicants who have been admitted to the Graduate School but who lack the required undergraduate prerequisite credits for the major chosen will be allowed to follow a program satisfactory to the major department. It is likely that their program will require more than the minimum residence.

DEGREES OF MASTER OF ARTS AND MASTER OF SCIENCE

Two degrees are conferred, Master of Arts for those proceeding in the liberal arts, and Master of Science for those proceeding in science or technology.

REQUIREMENTS.—A course for the master's degree requires a minimum of 30 credits and consists of one major and not more than two minor subjects. The program requires the equivalent of one academic year (two semesters), or at least 30 weeks, and may be met by full-time residence, part-time work, attendance in the summer sessions, or by any combination of these. Students not adequately prepared, or assistants and other part-time students, will require more than this time to attain the master's degree. Three credits earned in residence at another approved institution or in the extension classes of The Pennsylvania State College under certain conditions may be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within a period of six years.

At least 15 credit hours and a thesis equivalent of 6 credits must be devoted to the major subject. Fifteen credits must be obtained for work not open to undergraduates (courses with 500 numbers). Nine credits may be earned in courses open to upper-class and graduate students (courses with 400 numbers). A student's program must be approved by the head of the major department and the Dean.

Choice of the major and minor subjects must be dependent upon adequate preparation. Except by permission of the Dean, one minor subject must be chosen in a field of study different from that of the major. The mere completion of a stated amount of work does not entitle a candidate to recommendation for a degree. He must pass examinations upon such subjects and at such times as shall be designated by the departments concerned and must present an acceptable thesis.

THESIS.—Under the direction of the department in which the candidate's major subject is taken, he must prepare a thesis upon a suitable topic related to that subject. Under certain conditions a student may be permitted to complete the thesis *in absentia*. To obtain such permission the student must make satisfactory arrangements both with the major department and with the Office of the Dean.

For instructions concerning the form and the filing of typewritten copies of the thesis, see page 26.

DEGREE OF DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy (Ph.D.) is conferred in recognition of high attainments and productive scholarship in some special field of learning as evidenced (1) by the satisfactory completion of a prescribed period of study and investigation; (2) by the preparation of a dissertation involving independent research; and (3) by successfully passing examinations covering both the special subject and the general field of learning of which this subject forms a part.

RESIDENCE REQUIREMENTS.—A minimum of three academic years of resident graduate study and research are required for the attainment of a doctor's degree. Students not devoting full time to graduate study will be required to extend their work over a longer period. Credit for part-time work will be based on the actual time spent in the pursuit of graduate work. Work of equal grade done in residence at other institutions and residence for a master's degree, may be accepted by the College Examiner and the faculty as partial fulfillment of the requirements, but at least one academic year must be spent at this institution. While the minimum residence requirements must be met, it is understood that the time requirement is secondary to other considerations.

One-third of the residence requirements for a Ph.D. degree may be met by research work away from the College in branch laboratories of the College, or research laboratories not connected with other degree-granting institutions, or in other centers where there are opportunities for research under the following conditions:

(a) The candidate shall have had at least one year's work in residence.

(b) The plan must have the approval of the group committee.

(c) Reports on the work shall be made as directed by the group committee.

A candidate for a doctor's degree, doing graduate work off the campus, may obtain in this manner a maximum of six credits in an academic year, September to June, or nine credits in a calendar year. This does not apply to resident students temporarily assigned to other locations when, in the judgment of the Dean of the Graduate School, and the head of the department concerned, such assignment seems desirable.

Work done off the campus, which is to be credited toward a doctor's degree, must be scheduled *in advance* with the Dean of the Graduate School and the Registrar.

Work Done Elsewhere.—Acceptance of residence in another institution as partial fulfillment of the requirements toward an advanced degree, shall be by authority of the College Examiner. In determining to what extent the work done elsewhere may meet the course requirements at this institution each case will be decided on its merits by the group committee, or by the Dean and the heads of the departments concerned.

Program of Work.—A program shall consist of a major and one or two minor subjects. Two-thirds of the total time is to be devoted to the major subject. A division of the remaining one-third of the total time on the basis of two to one between the first and second minors is satisfactory. The heads of the major and minor departments or their representatives, together with the Dean, constitute a special group committee which shall have general charge of the arrangement of the program.

For the first year of graduate study leading to the doctor's degree, 30 credit hours is considered a full-time program. The first year's work may be substantially the same as that provided for the master's degree, and may lead to that degree, although that is not necessary.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department that he is prepared to proceed and is recommended by his group committee.

There is no specified number of courses or credits for the attainment of the doctor's degree. A program shall consist of such a combination of courses and research as is approved by the group committee for each individual student. Students devoting only a portion of their time will be credited on their residence requirements in proportion to the time actually spent in graduate study and research.

Dissertation.—The ability to do independent research must be proved by the preparation of a dissertation on some topic in connection with the major subject. It should represent a contribution on some worth-while problem presented in a scholarly manner. The contents and conclusions of the dissertation must be defended at the time of the final examinations.

The general subject of the dissertation must be determined at the time of admission to candidacy for the degree, and the completed dissertation, typewritten in triplicate copy, must be filed in the office of the College Librarian not later than one week prior to the commencement at which the candidate expects to take the degree.

For regulations concerning the form and the filing of the dissertation, see page 25.

Examinations.—Preliminary or qualifying examinations are required in the major and minor subjects to determine whether the candidate has made satisfactory progress and is entitled to the privilege of completing the requirements for the degree. These examinations are scheduled at a time when one-third of the residence requirements remain to be satisfied. They are given by a committee representative of the departments concerned and such other members as the Dean may appoint. The candidate must have satisfied the language requirements before taking the preliminary examinations.

Candidates for the degree of Doctor of Philosophy are required to have a reading knowledge of French and German unless an exception is arranged.

Upon the recommendation of the major department and the approval of the Dean, the substitution of another foreign language may be authorized for either French or German. In the case of foreign students, German and English will commonly serve as the foreign languages, unless one of these be the mother tongue. Certificates of proficiency must be obtained from the respective language departments of this College, or from the College Examiner provided language requirements have been met at another institution. Candidates not presenting certification of reading ability at the time of admission should make immediate arrangements to acquire that ability either through class work or by tutoring. The language requirements must be satisfied prior to the scheduling of the preliminary examinations.

The final examination for the doctor's degree is conducted by a committee representative of the departments concerned and such other members as may be appointed by the Dean, who shall also designate the time and place. The examination is oral, open to the public, and covers the whole field of study of the candidate without regard to courses that may have been taken either here or elsewhere.

PROFESSIONAL DEGREES IN EDUCATION

PREREQUISITES FOR CANDIDACY.—In order to provide graduate work which would utilize more fully the professional training and background of those holding bachelors' degrees from teachers colleges and schools of education, these professional degrees in education were established.

All candidates are required to have had at least 27 undergraduate credits in the field of education, including practice teaching. If a candidate elects to specialize in a subject-matter field, then certain additional prerequisites are required for that subject. The amount of preparation varies in the different fields. Full information concerning the preparation required by the various departments is on file in the office of the College Examiner. If there are deficiencies at the time of admission they must be removed before candidacy for a degree is completed. While making up deficiencies in prerequisite credits a student must follow a program satisfactory to the major department. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School until applicants have brought up their standing by further undergraduate work.

Candidates for the advanced degrees in education are required to take a qualifying comprehensive examination before completing the second half of their course requirements, which serves as a guide in outlining a program of study that will meet the individual needs of the candidate.

DEGREE OF MASTER OF EDUCATION

The degree of Master of Education represents general scholarship, acquaintance with the chief phases of educational literature, teaching skill, qualities of leadership in educational work, and ability to solve concrete problems in at least one special field of education.

The following regulations govern candidacy for the degree of Master of Education:

RESIDENCE AND COURSE REQUIREMENTS.—A minimum of 30 credits, 6 of which may be granted for an approved thesis. The program requires the equivalent of one academic year (two semesters), or at least 30 weeks, and may be met by full-time residence, part-time work, attendance in the summer sessions, or any combination of these. Three credits earned in residence

at another approved institution or in extension classes of The Pennsylvania State College, under certain conditions may be offered as partial fulfillment of the requirements. All requirements must be met within a period of six years.

A minimum of 24 credits is to be earned in graduate course work. It is expected that the larger part of this work shall be in courses open only to graduate students but the needs of the student shall be considered in arranging the best combination of courses (400 and 500 series) for the preparation of the candidate in his special field.

If a student looks forward to a career as a teacher, he may specialize in a specific field (as English, mathematics, Latin, etc.), and that shall be regarded as the major field, and a majority of the work is to be taken there. If a broader field is sought, a group major may be chosen (as social studies, general science, etc.). In this case a larger percentage of the 24 credits is to be devoted to the subjects forming the group major. The remainder of the program is devoted to a minor in the field of education, consisting of approximately one-third of the required credits, depending on the previous preparation, experience, and objectives of the candidate. In case the candidate's undergraduate preparation has not included courses in the scientific study of education and advanced educational psychology, a course in each of these fields must be included.

Those desiring to prepare as supervisors and administrators may choose a major and a minor within the curricula of Education. The following fields are recommended: secondary school principal, elementary school principal, superintendent of schools, guidance counselor, vocational director, or supervisor.

The candidate may choose one field of work for a major and another field for a minor. These majors prepare for State certificates in those fields where special certificates are given. It is possible to arrange programs of study concentrated in other fields.

ADVISORY COMMITTEE.—The heads of the major and minor departments or fields (or their representatives) together with the supervisor of the problem course (thesis) constitute a special advisory committee which shall approve the study program. In practice the general guidance of a student is centered in an adviser from the major department, who is familiar with the field in which the student is specializing.

THESIS.—Under the direction of a supervisor representing the major department or major field, an amount of time equivalent to six credits may be devoted to problem work and the preparation of a thesis. Under certain conditions this may be carried out in part *in absentia,* particularly when requirements are met by summer session attendance.

Course work may, under certain conditions, wholly or in part, take the place of the problem and thesis work. Application for the opportunity to substitute six credits of course work for the thesis must be filed with the candidate's advisory committee or adviser before the candidate completes more than 12 of the 30 credits required for the degree. The application must include the statement of the major and the titles and numbers of the courses which the candidate wishes to submit in substitution for the thesis.

For instructions concerning the form and the filing of the thesis, see page 25.

EXAMINATIONS.—Candidates for the Master of Education degree must pass a final comprehensive examination. The examination will be designed

to determine the ability of the candidate to apply the general, as well as the special, knowledge of his chosen field in practical situations.

DEGREE OF DOCTOR OF EDUCATION

The degree of Doctor of Education is conferred in recognition of scholarship and teaching or administrative skill as evidenced by (1) the satisfactory completion of a prescribed period of study, (2) the application of scientific principles in classroom teaching, in the supervision of instruction, or in administrative work, (3) by the preparation of a dissertation demonstrating ability to attack an educational problem with originality and independent thought, (4) by successfully passing examinations showing a satisfactory grasp of the field of specialization and its relation to allied subjects, and (5) by recognized leadership in the profession of education.

RESIDENCE.—An equivalent of three years of graduate study is required as a minimum for the doctor's degree. However, it is not required that the three years be continuous. Graduate study may be carried on through a longer period and paralleled by teaching or administrative work.

Work of equal grade done in residence at other institutions, and residence for a master's degree, may be accepted as partial fulfillment of the requirements, but in addition, at least one academic year or its equivalent must be spent in residence at this institution. For students pursuing work beyond the master's degree a combination of sessions amounting to at least 30 weeks is regarded as the equivalent of an academic year. While it may be possible to fulfill the minimum residence requirement as just stated, it is expected that candidates for the doctorate will be taking a much greater amount of work in the institution. Those completing requirements in summer sessions will continue during the regular school year in some educational situation, under the guidance of members of the faculty, study and research programs set up in summer courses.

One-third of the requirements (equivalent to a 30-credit year) for the degree of Doctor of Education may be met by research work pursued away from the campus in the school systems of the State, or in other approved centers not connected with degree-granting institutions, provided: (1) the plan be approved by the student's advisory committee, (2) reports on the projects be made as directed by the advisory committee, (3) not more than six credits be earned in an academic year, September to June, or nine credits in a calendar year.

Work done off the campus, which is to be credited toward a doctor's degree, must be scheduled *in advance* with the Dean of the Graduate School and the Registrar.

PROGRAM OF STUDY.—The program of study shall be so arranged as to lead toward high professional mastery within some area of educational service. A majority of the courses offered in fulfillment of the requirement will be in the major field of study. The remainder shall be in one or two minors bearing some functional relation to the major and to the work the candidate is planning to do. These minors may be in academic subjects or in some phase of education or psychology other than the major. In the case of persons intending to continue in classroom teaching rather than in administrative or supervisory positions, a larger proportion of the work may be assigned to the academic fields in which the candidate is teaching, to whatever extent the advisory committee may believe the background and the objectives of the par-

ticular candidate warrant. But every candidate for the degree of Doctor of Education must show through a comprehensive examination that he is familiar with current theories of education; that he understands and can apply the techniques and the findings of educational research so far as they bear upon the teaching of his subject; that he is prepared to read understandingly, and to contribute to, the technical professional literature in his field; and that he can criticize his own procedures in the light of historical trends and practices in this and other countries.

Command of the tools for a thorough study of the problems of education is necessary and must include familiarity with statistical methods. For certain students the requirements may include a reading knowledge of one or more foreign languages.

There is no specified number of courses or credits for the attainment of the doctor's degree. The general requirements are based not upon courses or credits but upon a definite residence, a satisfactory dissertation, the passing of a comprehensive examination, and possession of the qualities of professional leadership. A program shall consist of such a combination of courses and individual study and research as is approved by the advisory committee for each student.

ADVISORY COMMITTEE.—The heads of the major and minor departments or fields (or their representatives), the supervisor of the dissertation, together with the Dean of the Graduate School, constitute a special advisory committee which shall have charge of the arrangement of the study program.

DISSERTATION.—Evidence of a high degree of scholarship and ability to select, organize, and apply knowledge must be presented by the candidate in the form of a written dissertation. The candidate must demonstrate capacity for independent thought and ability and originality in the application of educational principles or in the development of new generalizations under scientific controls. The topic and outline of the proposed thesis must have the approval of the advisory committee.

For instructions concerning the form and the filing of the dissertation, see page 25.

EXAMINATION AND ADMISSION TO CANDIDACY.—In order to be admitted to full candidacy for the degree each candidate shall pass preliminary qualifying examinations administered by the committee on qualifying examinations. The qualifying examinations may not be taken until after one semester of work has been completed at this institution. They are scheduled at a time when one-third of the residence requirements remain to be satisfied. Examinations will be held at times arranged with the head of the major department. The qualifying examinations will be designed to test (1) the candidate's general scholastic preparation and professional background; and (2) his ability to integrate and apply his knowledge in his fields of specialization to practical situations so as to reflect an intelligent mastery of the subjects.

Three of the important factors taken into consideration in passing judgment upon the application of a candidate for admission to candidacy are:

(a) Previous scholastic record at this institution and other institutions attended;

(b) Achievement in qualifying examinations;

(c) Estimates of his personal and professional qualifications by members of the advisory group.

The advisory committee will make recommendations to the Dean of the Graduate School, and candidates will be advised of the decision with

regard to their applications for candidacy within 10 days following the date of each qualifying examination.

Candidates who have fulfilled all other requirements for the degree will, on recommendation of their advisory committee, be permitted to take the final oral examination for the degree. The committee in charge of this examination will consist of the student's advisory committee and others appointed by the Dean of the Graduate School. The examination will be based upon the dissertation and related problems. Arrangements for taking the final examination must be made with the Dean of the Graduate School, through the advisory committee and the major department, not later than two weeks prior to a commencement date.

PROFESSIONAL DEGREE IN FORESTRY

The degree of Master of Forestry represents scholastic ability, acquaintance with forestry literature, and technical knowledge of one or more of the several specialized fields in forestry or wood utilization. It is offered to provide an opportunity for additional study in a student's particular field of interest, rather than for research work on a special problem, though such work is not precluded under the requirements for the degree.

PREREQUISITES FOR CANDIDACY.—A candidate is required to hold a baccalaureate degree, or its equivalent, from a recognized professional school of forestry. Full information concerning the preparation required in either general forestry or wood utilization is on file in the office of the College Examiner. If there are deficiencies at the time of admission they must be removed before candidacy for a degree is completed. While making up deficiencies in prerequisite credits, the student must follow a program approved by his advisory committee. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School until applicants have brought up their standing by further undergraduate work.

RESIDENCE AND COURSE REQUIREMENTS.—A minimum of 30 credits is required for the degree of Master of Forestry. These credits are to be taken in the best arrangement of courses bearing 400 and 500 numbers suited to the needs of the individual student. Although not required, a maximum of 6 credits may be assigned to a thesis upon approval and recommendation of the head of the Forestry Department. All requirements must be met within a six-year period.

A maximum of three credits may be earned in extension classes of The Pennsylvania State College, or in resident classes of other approved institutions, provided these credits have the approval of the College Examiner and fit into the program of the student.

A student should choose one field of work for his major interest with one or two related minor fields. The proportion of credits to be taken in the major and minor fields of study will be determined in consultation with an advisory committee. Ordinarily this committee consists of the head of the Forestry Department, and the professors in charge of the major and minor fields.

TECHNICAL DEGREES

ADMISSION.—A graduate of the School of Chemistry and Physics, of the School of Engineering, or of the School of Mineral Industries of The Pennsylvania State College may be admitted to candidacy for a technical degree, provided he submits evidence of having been engaged for a period of not less

than three years in acceptable professional work in the field of engineering in which the application for the degree is made.

A technical degree may also be granted to an engineer of approved practical experience, who is a graduate in engineering of another institution of equal standing, on completion of at least three years of full-time teaching or research work in engineering in a professorial rank in this institution and upon presentation of an acceptable thesis and the fulfillment of all other requirements for technical degrees. Applicants who are eligible for the technical degrees are admitted to the Graduate School by the College Examiner.

REGISTRATION.—The candidates for technical degrees must file with the College Examiner an application filled out in duplicate on the prescribed forms, approved by the head of the department in which the undergraduate work was completed. The application should be accompanied by the matriculation fee of $5.

The times for registration for these degrees are the same as for resident students. A candidate must be registered during two regular sessions.

DEGREES AND REQUIREMENTS.—The technical degrees are as follows: Architectural Engineer, Chemical Engineer, Civil Engineer, Electrical Engineer, Industrial Engineer, Ceramic Engineer, Mechanical Engineer, Engineer of Mines, Metallurgical Engineer, Petroleum Engineer.

Not less than three years shall have elapsed from the time of receiving the first degree before a graduate of this institution shall be permitted to file his application for a technical degree. The application for a technical degree shall include evidence of a satisfactory professional record, which must be approved by the executive committee of the undergraduate School concerned.

In order to be recommended for a technical degree the candidate must prepare a thesis on a subject related to his profession. He must register in the manner specified in the foregoing paragraph and pay the registration and diploma fees. He may be required to appear in person to defend his thesis.

THESIS.—Immediately following registration the candidate must submit for approval an outline of his proposed thesis, and at least six weeks prior to the day on which the degree is to be conferred, the complete thesis must be in the office of the head of the department concerned.

For regulations concerning the form and filing of the thesis, see below.

FEES.—Each candidate for a technical degree must pay a matriculation fee of $5 and a diploma fee of $10 when recommended to the College Senate for the degree. The matriculation fee is payable through the Office of the College Examiner, whereas the diploma fee is payable through the Office of the Bursar. Both fees are payable by check drawn to the order of The Pennsylvania State College.

REGULATIONS FOR THESES AND DISSERTATIONS

THESES.—It is required that three typewritten copies must be presented. They are due in the office of the College Librarian not later than one week prior to the day on which the degree is to be conferred.

Before arranging for the typing the candidate must obtain information from the College Librarian concerning the format, paper, illustrations, etc.

A thesis thus submitted and approved becomes wholly the property of the College, and may not be published, in whole or in part, without authorization of the Dean of the Graduate School and the head of the department concerned.

These regulations apply to candidates for the master's and technical degrees.

DISSERTATIONS.—Candidates for the doctor's degree must satisfy one of the following requirements as to the dissertation not later than one week prior to the day on which the degree is to be conferred:

1. Publication of the dissertation in a manner satisfactory to the College Librarian and deposit of 100 copies in the College Library; or

2. Presentation of a typewritten abstract, satisfactory to the major department and the College Librarian, and the sum of $25. The Librarian will then arrange for the printing of the abstract. Fifty copies of the printed abstract will be furnished to the candidate without additional cost.

Before arranging for the typing or publication of the dissertation, or the abstract, the candidate must obtain information regarding the format, title page, etc., from the College Librarian.

The regulations apply to candidates for the Doctor of Philosophy and Doctor of Education degrees.

GRADUATE ASSISTANTS, SCHOLARS, AND FELLOWS

I. OPEN TO GRADUATES OF ANY COLLEGE OR UNIVERSITY

GRADUATE ASSISTANTS.—A number of appointments to graduate assistantships are made each year. Appointees must show promise of ability to do research or to carry on graduate study. Appointments are for 10 months, September 1 to June 30. Service required by the College is one-half the duties of full-time assistants or instructors in the department in which employed. Enrollment in the Graduate School is obligatory and not more than two-thirds of a full schedule may be carried or not more than two-thirds of a year's graduate work may be completed in any one year. Graduate assistants are eligible to reappointment while candidates for advanced degrees. Graduate assistants are exempt from the incidental fee and practicum fees in their major department. The stipend is $1000. Applications should be made direct to the department.

GRADUATE SCHOLARS.—Scholarships with no stipend, but exemption from the incidental and practicum fees, are assigned in limited numbers to the various departments. The holders are required to render some service to the department but a qualified recipient may become a candidate for the master's degree on the basis of one year in residence. Applications should be made to the Dean of the Graduate School.

GRADUATE STIPEND SCHOLARS.—These scholarships are granted on the basis of one-fourth time service to the College, for which a stipend of $500 is allowed. The appointments are made for 10 months, September 1 to June 30. Appointees are exempt from incidental and practicum fees. Enrollment in the Graduate School is obligatory, but no more than four-fifths schedule may be carried. Applications should be made to the departments.

DUPONT FELLOW IN CHEMISTRY.—Stipend $750, provided by E. I. duPont de Nemours Company. Candidates recommended by the Department of

Chemistry must be approved by a member of the fellowship committee of the duPont Company.

SPECIAL RESEARCH AND INDUSTRIAL FELLOW.—Each year there are several research fellowships offered by various outside agencies for the study of special problems. The stipend varies.

II. OPEN ONLY TO GRADUATES OF THE PENNSYLVANIA STATE COLLEGE

THE JOHN W. WHITE FELLOW.—Stipend $600, assigned to each of two members of the graduating class on the basis of scholarship, need, character, and general attitude toward the College.

THE ELLIOTT FELLOW IN ENGINEERING RESEARCH.—An annuity provided by W. S. Elliott, of Pittsburgh, for a fellow in engineering who must be a graduate of this College.

GRADUATE COURSES OFFERED BY THE VARIOUS DEPARTMENTS

The course descriptions which follow are arranged alphabetically, with some exceptions, according to departments. If any specific course cannot be located readily, refer to the table of contents, page 2.

The courses of instruction in all departments of the College are numbered in accordance with a unified plan, as follows:

UNDERGRADUATE COURSES, numbered 1 to 399, are general courses accepted in fulfillment of the requirements for the bachelor's degrees.

UPPER-CLASS AND GRADUATE COURSES, numbered 400 to 499, are advanced courses open for credit to undergraduate students of at least junior standing and to graduate students under the restriction that no more than nine credits in these courses may be offered in fulfillment of the requirements for the degrees of M.A. and M.S.

GRADUATE COURSES, numbered 500 to 599, are special courses for graduate students only. The name of the person in charge of the instruction for the course usually follows the description. Senior students of The Pennsylvania State College not required to carry a full program for graduation, with permission of the Dean of the School in which they are enrolled and of the Dean of the Graduate School, may attend such courses and be allowed credit under special conditions. *Many departments reserve the right to say which of certain graduate courses may be given in any semester; the heads of departments should be consulted.*

The figures in parentheses following the title of the course indicate the number of credits granted for that course. A considerable number of graduate courses are offered in the summer sessions. When these courses are also given during the regular academic year they are not listed separately as summer session courses in this announcement. For a complete list of courses given during a specific summer or summer session, consult the *Complete Announcement of the Summer Sessions* for that particular year. In this announcement courses given during the summer session *(but not during the regular academic year)* have numbers followed by the letter "S." Courses given in extension only have numbers followed by the letter "X."

AERONAUTICAL ENGINEERING

PROFESSOR DAVID J. PEERY, Ph.D.
Head of the Department

Aero. E. 501. Airplane Stability and Control (3) General analysis of longitudinal and lateral stability of airplanes; characteristics of flight control devices. Prerequisite: Aero. E. 403. Lecture 3 hours. PROFESSOR D. J. GILDEA

Aero. E. 502. Aircraft Propeller Design (3) Propeller characteristics by blade element analysis and test data; blade design and stress analysis; pitch changing mechanisms. Prerequisites: Aero. E. 403, M. E. Des. 6, 8. Lecture 3 hours. PROFESSOR D. J. GILDEA

Aero. E. 503. Airplane Performance (3) Analytical approach to airplane performance problems; reduction of flight test data. Prerequisite: Aero. E. 403. Lecture 3 hours. PROFESSOR D. J. GILDEA

Aero. E. 504. Rotary Wing Aircraft (3) Types of rotary wing aircraft, rotor arrangements, power transmission, and control mechanisms; helicopter performance in vertical and forward flights; dynamic and aerodynamic loads on rotor blades. Topics are treated in more detail and at higher level than in Aero. E. 407. Prerequisites: Aero. E. 403, 409. Lecture 3 hours. PROFESSOR D. J. PEERY

Aero. E. 505. Aircraft Vibration and Flutter (3) Vibrating systems with several degrees of freedom; analysis of flutter speed of an airplane wing considering bending, torsion, and aileron motions; other types of aircraft flutter. Prerequisites: Aero. E. 1, M. E. Des. 8. Lecture 3 hours. PROFESSOR D. J. PEERY

Aero. E. 506. Advanced Aircraft Structures (3) Deflections of beams and trusses; statically indeterminate structures; shear-flow analysis and shearing deformations of multi-cell semi-monocoque structures; effects of discontinuities in wing and fuselage structures. Prerequisite: Aero. E. 409. Lecture 3 hours. PROFESSOR D. J. PEERY

Aero. E. 507. Aircraft Gas Turbines and Jet Propulsion Engines (3) History and theory of gas turbines for propeller and jet propulsion installations; theoretical and design analysis of various combinations of the basic elements; compressor, combustion chamber, and turbine. Topics are treated in more detail and at higher level than in Aero. E. 408. Prerequisite: M. E. 413. Lecture 2 hours, practicum 3 hours. PROFESSOR S. K. HOFFMAN

Aero. E. 508. Advanced Aircraft Engine Design I (4) Fundamental principles of design of aircraft engines; performance and stress computations. Assembly drawings of a complete engine are started. Prerequisite: M. E. 413. Lecture 2 hours, practicum 6 hours. PROFESSOR S. K. HOFFMAN

Aero. E. 509. Advanced Aircraft Engine Design II (4) Continuation of stress computations and assembly drawings begun in Aero. E. 508; completion of design report. Prerequisite: Aero. E. 508. Lecture 2 hours, practicum 6 hours. PROFESSOR S. K. HOFFMAN

Aero. E. 510. Aerodynamics of Compressible Fluids (3) One-dimensional motion, shock waves, flow through nozzles and other channels; airfoils in high-speed flow, critical Mach number; subsonic, transonic, and supersonic regions. Prerequisites: Aero. E. 1, Math. 84, M. E. 2. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Aero. E. 401a,b,c. Aeronautical Engineering Projects (2-12)

Aero. E. 402. Airplane Engine Design (5) Fee $2.
PROFESSOR S. K. HOFFMAN

Aero. E. 403. Applied Aerodynamics (3) PROFESSOR D. J. GILDEA

Aero. E. 404. Airplane Design (5) Fee $2. PROFESSOR D. J. GILDEA

Aero. E. 407. Rotary Wing Aircraft (3) PROFESSOR D. J. PEERY

Aero. E. 408. Aircraft Gas Turbines and Jet Propulsion Engines (3)
PROFESSOR S. K. HOFFMAN

Aero. E. 409. Airplane Detail Design (4) Fee $2. PROFESSOR D. J. PEERY

Aero. E. 410. Airplane Power Plants (4) Fee $2.
PROFESSOR S. K. HOFFMAN

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

PROFESSOR R. ADAMS DUTCHER, M.S., M.A., D.Sc.
Head of the Department

Agr. Biochem. 501. Enzymes (2) Lectures and assigned reading reviewing investigational work and recognized theories concerning the probable nature of enzymes, enzyme action, influence of chemical environment on enzyme action, and biological applications. Prerequisite: Agr. Biochem. 417. Lecture 2 hours. PROFESSOR C. O. JENSEN

Agr. Biochem. 502. Physical Chemistry of the Cell (3) Lectures and assigned reading reviewing current literature relative to physical chemistry of living tissues and life processes. Prerequisite: Agr. Biochem. 426. Lecture 3 hours.
PROFESSOR M. W. LISSE

Agr. Biochem. 503. Research (3-15) The prosecution of an assigned problem under the guidance of an instructor. Prerequisite: Agr. Biochem. 417. For certain problems additional courses may be considered as prerequisite. Fee $3 per credit. PROFESSOR R. A. DUTCHER AND STAFF

Agr. Biochem. 504. Thesis Research (3-15 per semester) Fee $3 per credit.
PROFESSOR R. A. DUTCHER AND STAFF

Agr. Biochem. 505. Vitamins and Dietary Deficiency Diseases (2) Lectures, conferences, and assigned reading. Prerequisite: Agr. Biochem. 437.
PROFESSOR R. A. DUTCHER

Agr. Biochem. 506. Vitamin Assay Methods (2) Lectures, conferences, and demonstrations dealing with approved methods of vitamin assay and including demonstrations of typical vitamin deficiency syndromes in the rat. Prerequisite: Agr. Biochem. 505. Fee $6. PROFESSOR N. B. GUERRANT

Agr. Biochem. 507a. Seminar in Physiological Chemistry and Nutrition (1)
PROFESSORS R. A. DUTCHER, N. B. GUERRANT, A. K. ANDERSON, R. V. BOUCHER, R. C. MILLER, G. H. PRITHAM

Agr. Biochem. 507b. Seminar in Foods and Analytical Chemistry (1)
PROFESSORS H. O. TRIEBOLD, P. M. ALTHOUSE

Agr. Biochem. 507c. Seminar in Plant, Soil, Insecticide Chemistry (1)
PROFESSORS D. E. H. FREAR, C. O. JENSEN

Agr. Biochem. 508. Researches in Plant Chemistry (3) Lectures and assigned readings reviewing the more important chemical investigations in plant chemistry. Prerequisite: Agr. Biochem. 437. Lecture 3 hours.
PROFESSOR C. O. JENSEN

Agr. Biochem. 509. Biochemical Methods (3) An advanced laboratory course involving special methods used in biochemical research on plant and animal materials. Prerequisite: Agr. Biochem. 437. Practicum 9 hours. Fee $12.50.
PROFESSOR A. K. ANDERSON

Agr. Biochem. 510. Proteins (2) The chemical constitution of proteins, their physical and biochemical properties, their function in nutrition, and their fate in metabolism. Prerequisite: Agr. Biochem. 437. Lecture 2 hours.
PROFESSOR A. K. ANDERSON

Agr. Biochem. 511. Carbohydrates (2) Study of research work dealing with the carbohydrates and their metabolism in the plant and animal organisms. Prerequisite: Agr. Biochem. 437. Lecture 2 hours. PROFESSOR C. O. JENSEN

Agr. Biochem. 512. Lipids (2) Investigations on the biochemistry of fats and related substances. Prerequisite: Agr. Biochem. 437. Lecture 2 hours.
PROFESSOR H. O. TRIEBOLD

Agr. Biochem. 513. Physicochemical Measurements Used in Biological Research (4) Laboratory course, quantitative in nature, valuable as preparation for Agr. Biochem. 502. Hydrogen-ion concentration, electrometric titration, buffers, oxidation-reduction potential, and membrane potential. Prerequisite: Agr. Biochem. 425 or Chem. 41, 43. Lecture 2 hours, practicum 6 hours. Fee $9. PROFESSOR M. W. LISSE

Agr. Biochem. 514. Physicochemical Measurements Used in Biological Research (3) A continuation of Agr. Biochem. 513. Fee $9.
PROFESSOR M. W. LISSE

Agr. Biochem. 515. Biometry (2) The application of statistical methods to research problems in biochemistry and biology. Prerequisites: Agr. Biochem. 437, Math. 30. PROFESSOR R. C. MILLER

Agr. Biochem. 516. Chemistry of Insecticides and Fungicides (2) Lectures and assigned readings dealing with chemical investigations of materials used in the control of insects and plant diseases. Prerequisites: Chem. 30, 31: Agr. Biochem. 425 or Chem. 41, 43; Agr. Biochem. 417. Lecture 2 hours.
PROFESSOR D. E. H. FREAR

Agr. Biochem. 517. Endocrine Secretions (2) Chemistry of hormones and their physiological significance. Prerequisite: Agr. Biochem. 437. Lecture 2 hours. PROFESSOR G. H. PRITHAM

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Agr. Biochem. 403. Dairy Chemistry (3) Fee $12.50.
PROFESSOR H. O. TRIEBOLD

Agr. Biochem. 404. Food Chemistry (4) Fee $15.
PROFESSOR H. O. TRIEBOLD

Agr. Biochem. 405S. Biological Chemistry for Teachers of High School Science (3)

Agr. Biochem. 413. Principles of Animal Nutrition (3)
PROFESSOR M. W. LISSE

Agr. Biochem. 417. Methods of Agricultural Analysis (4) Fee $15.
PROFESSOR H. O. TRIEBOLD

Agr. Biochem. 418. Soil and Plant Analysis (4) Fee $15.
PROFESSOR C. O. JENSEN

Agr. Biochem. 421. Chemistry of Milling and Baking (3) Fee $12.50.
PROFESSOR H. O. TRIEBOLD

Agr. Biochem. 425. Biophysical Chemistry (4) PROFESSOR M. W. LISSE

Agr. Biochem. 426. Biocolloids (3) Fee $10. PROFESSOR M. W. LISSE

Agr. Biochem. 427. Potentiometric Theory and Technique (3) Fee $5.
PROFESSOR M. W. LISSE

Agr. Biochem. 437. General Biochemistry (5) Fee $15.
PROFESSORS A. K. ANDERSON, G. H. PRITHAM

Agr. Biochem. 438. Physiological Chemistry (Clinical Methods) (5) Fee $15.
PROFESSOR A. K. ANDERSON

Agr. Biochem. 439. Problems in Agricultural Chemistry (3-5) Fee $3 per credit. PROFESSOR R. A. DUTCHER AND STAFF

AGRICULTURAL ECONOMICS

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.
Head of the Department of Agricultural Economics and Rural Sociology

Agr. Ec. 500. Seminar in Agricultural Economics (1-6) A review of current literature and problems. Lecture 1 hour per credit.

Agr. Ec. 501. Applied Theory in Agricultural Economics (3) Economic principles having important application to agriculture; agricultural organization and current farm problems in the light of principles of economic theory. Prerequisite: 6 credits in agricultural economics or economics. Lecture 3 hours. PROFESSOR G. E. BRANDOW

Agr. Ec. 502. Economic Problems in the Marketing of Fruits and Vegetables (3) Economics of marketing fruits and vegetables in fresh and processed form; comparative advantage of various areas of production, consumption trends, costs and methods of distribution, influence of governmental policies, and types of marketing organizations. Conference 3 hours.
PROFESSOR W. A. LEE

Agr. Ec. 503. Research Methods in Farm Management (1-3) Evaluation of research procedures, methods, results, and needs in the field; emphasis on their application to specific research problems. Prerequisites: Agr. Ec. 6, Econ. 14. Recitation 1 to 3 hours.

Agr. Ec. 505. Advanced Agricultural Statistics (3) Application to problems in rural social sciences of methods of sampling, measures of relationship, techniques of prediction, and tests of statistical significance. Prerequisite: 3 credits in statistics. Lecture 3 hours. PROFESSOR G. E. BRANDOW

Agr. Ec. 507. Seminar in Farm Management (1-6) Special problems relating to the organization and operation of the farm business. Prerequisites: Agr. Ec. 6, Econ. 14.

Agr. Ec. 515. Economic Problems in the Marketing of Dairy Products (3) Economic problems as they are encountered in the process of marketing; particular attention to governmental regulation in pricing and marketing.
PROFESSOR C. W. PIERCE

Agr. Ec. 517. Problems and Policies of Farmer Co-operatives (3) Specific types of co-operative organizations, their problems, policies, and progress; relationships existing between co-operatives, between co-operatives and other business organizations, and between co-operatives and the public. Prerequisite: Agr. Ec. 17. Lecture 3 hours. PROFESSOR J. K. STERN

Agr. Ec. 525. Research Methods in Rural Social Sciences (2) The scientific method in planning and conducting research in agricultural economics and rural sociology; interviewing, use of questionnaires, qualitative analysis, quantitative analysis, sampling, control groups, scales, indices, and thesis writing. Prerequisite: 9 credits in social science. Lecture 2 hours. PROFESSOR M. E. JOHN

Agr. Ec. 533. Economic Problems in the Marketing of Poultry and Eggs (3) Detailed treatment of special problems such as the marketing of particular types and grades of product, the operation of certain markets, and the performance of selected marketing functions. Prerequisites: Econ. 14, P. H. 1. Recitation 3 hours. PROFESSOR C. A. BECKER

Agr. Ec. 540. Thesis in Agricultural Economics (6) The preparation of the required thesis for the degree of Master of Science in agricultural economics while in residence at The Pennsylvania State College.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Agr. Ec. 400, 400X. Public Policies in Agriculture (1-2)

Agr. Ec. 404. Farm Finance (2) PROFESSOR L. F. MILLER

Agr. Ec. 405. Statistics Applied to the Rural Social Sciences (3) Fee $2. PROFESSOR G. E. BRANDOW

Agr. Ec. 407. Advanced Farm Management (3) PROFESSOR L. F. MILLER

Agr. Ec. 420. Agricultural Prices (3) Fee $2. PROFESSOR G. E. BRANDOW

Agr. Ec. 421. Land Economics (3) PROFESSOR W. E. KEEPPER

AGRICULTURAL EDUCATION

PROFESSOR HENRY S. BRUNNER, M.S., Ph.D.

Head of the Department

Agr. Ed. 501v. History of Agricultural Education (1-3) Development of training for the vocation of agriculture from primitive conditions to the present; emphasis upon the introduction of agricultural instruction into the high school since 1900. Lecture 3 hours. PROFESSOR W. F. HALL

Agr. Ed. 502v, 502vX. Teaching Vocational Agriculture (1-3) Organizing subject matter with respect to its vocational value and methods of presentation. Students may specialize in methods of teaching animal husbandry, horticulture, etc. Lecture and conference 3 hours.

Agr. Ed. 503v, 503vX. Research in Agricultural Education (1-6 per semester) Dealing with various phases of such subjects as state teacher training in agricultural education, and measuring results of teaching vocational agriculture. Conferences. PROFESSOR H. S. BRUNNER AND STAFF

Agr. Ed. 504v. Agricultural Education Seminar (1 per semester) PROFESSOR H. S. BRUNNER AND STAFF

Agr. Ed. 506v, 506vX. Problems in County Vocational Supervision (1-3) To meet the needs of county agricultural supervisors and directors of vocational schools, including such topics as co-operation with county superintendents, vocational supervision, plans of work, community meetings and organizations. Lecture 1 to 3 hours. PROFESSOR W. F. HALL

Agr. Ed. 508v. State and County Administration and Supervision of Agricultural Education (1-3) Organization and administration of state, county, township, and district systems of agricultural education, with special reference to vocational work; state and federal legislation; administration and supervision of agricultural education in secondary schools and colleges. Lecture 3 hours. PROFESSOR H. S. BRUNNER

Agr. Ed. 509v, 509vX. Teacher Training in Agricultural Education (1-6) Problems in agricultural education; construction of college curricula, courses of study, and organization of college departments for the training of agricultural teachers. Lecture 3 hours. PROFESSOR C. S. ANDERSON

Agr. Ed. 520v, 520vX. Scientific Method in the Study of Agricultural Education (1-4) Methods of procedure in education investigation and experimentation, accompanied by a critical examination of studies made in agricultural education. Lecture 2 hours. PROFESSOR H. S. BRUNNER

Agr. Ed. 521v, 521vX. Scientific Method in the Study of Agricultural Education (1-4) A continuation of Agr. Ed. 520v; emphasis upon the statistical techniques for students' individual problems. Reports and discussions. Lecture 2 hours. PROFESSOR W. F. HALL

Agr. Ed. 522v, 522vX. Field Studies in Agricultural Education (1-4) The organization and administration of agricultural education in its local bearings; a laboratory course based upon detailed surveys of local school conditions. Lecture 2 hours. PROFESSOR H. S. BRUNNER AND STAFF

Agr. Ed. 523v, 523vX. Field Studies in Agricultural Education (1-4) PROFESSOR H. S. BRUNNER AND STAFF

Agr. Ed. 524v, 524vX. Annual Plan of Work (1-3) A detailed study of the agricultural education needs of each student's community and the outlining of annual plans of work. Lecture 2 hours. PROFESSOR C. S. ANDERSON

Agr. Ed. 525v. Master's Thesis (1-6) Conferences and assignments in connection with the preparation of the required thesis for the degree of Master of Science in agricultural education. PROFESSOR H. S. BRUNNER AND STAFF

Agr. Ed. 530v. Agricultural College Teaching (3) Selection and organization of subject matter for specific courses, methods of learning, teaching devices, the technique of teaching, and the measurements of the results of teaching. Lecture 3 hours. PROFESSOR H. S. BRUNNER AND STAFF

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Agr. Ed. 416v. Rural Education (3) PROFESSOR W. F. HALL

Agr. Ed. 417v, 417vX. Rural Education Survey (2) PROFESSOR H. S. BRUNNER

Agr. Ed. 418v, 418vX. Survey of Vocational Education in Agriculture (1-3) PROFESSOR H. S. BRUNNER

Agr. Ed. 420v, 420vX. Advanced Visual and other Sensory Aids in Teaching Agriculture (1-6) PROFESSOR D. R. MCCLAY

Agr. Ed. 421v. Objectives in Rural Education (3) PROFESSOR W. F. HALL

Agr. Ed. 422v, 422vX. Supervision of Vocational Education in Agriculture (1-3) PROFESSOR D. R. MCCLAY

Agr. Ed. 434v, 434vX. Agricultural Developments (1-6) PROFESSOR H. S. BRUNNER

AGRICULTURAL ENGINEERING

PROFESSOR RALPH U. BLASINGAME, B.S.
Head of the Department

Agr. Eng. 500. Advanced Electro-Agriculture (2-4) Considerations governing the application and economic use of electrical energy to the home and farm; refrigeration, air conditioning, storage, and processing of agricultural products. A student is given a choice of the type of problem in which he is most interested for his individual study. Written reports.

Agr. Eng. 501. Advanced Farm Machinery (2-4) Duty and maintenance cost of farm machinery. Seminar: written reports.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Agr. Eng. 400. Agricultural Engineering Problems and Seminar (2-6)

Agr. Eng. 401a,b,c,dS. Farm Mechanics for the Teacher of Vocational Agriculture (1½-6) Fee $1.50 per unit of 1½ credits.

Agr. Eng. 402. Functional Design of Farm Structures (3)

Agr. Eng. 406. Advanced Dairy Engineering (3) Fee $2.50.

AGRONOMY

PROFESSOR HERBERT R. ALBRECHT, M.S., Ph.D.
Head of the Department

Agro. 501. Soil Fertility (4) Factors which determine soil fertility; special attention to the diagnoses of soil and plant problems through field appraisal, laboratory analyses, and plant symptoms; the agronomic properties of manures, fertilizers, and soil amendments, the influence of practices upon yield and composition and probable nutritive value of the crops. Prerequisites: Agro. 431, Bot. 406. PROFESSOR F. G. MERKLE

Agro. 502. Crop Improvement (3-5) Conferences, lectures, assigned reading, and field and laboratory research covering crop improvement as applied to one or more specific crops selected by the student. Prerequisites: Agro. 511, Hort. 7. Conference weekly.

Agro. 503. Agronomy Seminar (1) A weekly meeting where papers and discussions will be presented by students and staff members. Each student will present a paper on some phase of his major subject.

Agro. 504. Research in Soils (4-6) Investigation of some problem involving the related literature and field and laboratory research. Prerequisites: Agr. Biochem. 417 or Chem. 283, 284, Agro. 419, 431. Fee $5. PROFESSOR F. G. MERKLE

Agro. 505. Research in Soils (4-6) A continuation of Agro. 504. Prerequisite: Agro. 504. Fee $5. PROFESSOR F. G. MERKLE

Agro. 506. Chemical and Biochemical Soil Properties (4) Analyses of the important chemical and biochemical reactions occurring in soils, the con-

ditions which control these reactions and their importance in soil genesis and plant growth; laboratory work of the more typical and significant analytical procedures; lectures and reviews of current literature and practicum. Prerequisites: Agro. 419, Agr. Biochem. 417 or Chem. 283, 284. Fee $5.
PROFESSOR F. G. MERKLE

Agro. 507. Physical and Physicochemical Soil Properties (4) Analyses of the important physical and physicochemical properties and reactions occurring in soils, the conditions which control these reactions, and their importance in soil genesis and plant growth; laboratory work in the conduct of the more typical and significant procedures. Lectures, review of current literature, and practicum. Prerequisites: Agro. 419, Agr. Biochem. 417 or Chem. 283, 284, Phys. 217, 218. Fee $5. PROFESSOR F. G. MERKLE

Agro. 508. Special Pasture Problems (3)

Agro. 509. Genetics of Crop Plants (3) The inheritance in crop plants with particular reference to factor interaction, the genetic aspects of linkage and crossing-over, quantitative inheritance, and heterosis. Prerequisite: Bot. 423.
PROFESSOR W. M. MYERS

Agro. 510. The Application of Cytogenetics to Plant Breeding (3) Cytogenetics, including chromosome structure and behavior, chromosome alterations, polyploidy, interspecific hybridization and their applications to plant breeding. Prerequisite: Bot. 505. PROFESSOR W. M. MYERS

Agro. 511. The Breeding of Farm Crops (3) The application of genetic principles to the improvement of crop plants. Prerequisite: Hort. 7.
PROFESSOR M. T. HENDERSON

Agro. 512. Field Plot Technique (3) The design and analyses of field experiments. Prerequisites: Math. 8, Com. 90, or Agr. Ec. 505.
PROFESSOR M. T. HENDERSON

Agro. 513. Research in Farm Crops (4-6) Advanced studies related to various problems of crop research. Prerequisite: Agro. 509, 511.

Agro. 514. Seminar in the Breeding of Farm Crops (1) Literature and research in the field of farm crops breeding.

Agro. 515. Seminar in the Genetics of Farm Crops (1) Literature and research related to the genetics of farm crops.

Agro. 516. Humus (2) The origin and chemical nature of soil organic matter, its importance in soil processes, and its decomposition. Prerequisites: Agro. 419, 431. PROFESSOR A. C. RICHER

Agro. 517. Farm Crops Ecology (2) The ecological factors influencing the distribution and production of field crops. Prerequisites: Math. 8 or Bot. 406, Com. 90. Lecture 2 hours. PROFESSOR L. L. HUBER

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Agro. 416. The Classification and Mapping of Soils (4)
PROFESSOR H. W. HIGBEE

Agro. 419. Soil Properties (5) Fee $5. PROFESSOR F. G. MERKLE

Agro. 420. Advanced Soil Mapping (2) PROFESSOR H. W. HIGBEE

Agro. 422. Soil Conservation (3) PROFESSORS F. G. MERKLE, R. B. ALDERFER

Agro. 423. Meadow and Pasture Management (3)
PROFESSOR J. K. THORNTON

Agro. 431. Advanced Soil Fertility (3) Fee $5. PROFESSOR F. G. MERKLE

ANIMAL HUSBANDRY

PROFESSOR FRANKLIN L. BENTLEY, M.S.
Head of the Department

A.H. 501. Pedigree Study (1-6) Research work in breed study history, and analytical study of breed pedigrees, and a complete survey of the herd, flock, or stud book. PROFESSOR W. L. HENNING

A.H. 502. Research in Meats (1-6 per semester) Investigational work pertaining to methods of handling, cutting, and processing meat and meat products; temperatures and their effect on tenderness, rancidity, and length of storage; freezer storage of meat and meat products; curing; current problems of the meat industry. Prerequisite: A.H. 421.
PROFESSOR P. T. ZIEGLER

A.H. 503. Livestock Management (3) The handling of purebred herds and flocks. The relation of the livestock breeders to the public and methods of developing purebred herds and flocks through careful breeding.
PROFESSOR F. L. BENTLEY AND STAFF

A.H. 504. Livestock Health Problems (3) Problems dealing with the regulations governing the movement of livestock with special reference to control measures applicable to diseases and disease groups common to men and animals. Prerequisites: A.H. 5, 415. PROFESSOR J. F. SHIGLEY

A.H. 505. Advanced Animal Breeding (1-5) Special problems in animal genetics as applied to breeding and improvement of horses, cattle, sheep, and swine. Prerequisites: A.H. 22, Bot. 22. PROFESSOR W. L. HENNING

A.H. 506. Research in Animal Husbandry (2-10 per semester) The prosecution of an assigned problem under the guidance of an instructor. Prerequisites: A.H. 415, 421; or 426.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

A.H. 415. Advanced Anatomy and Physiology (3) PROFESSOR J. F. SHIGLEY

A.H. 421. Advanced Meat Studies (3) PROFESSOR P. T. ZIEGLER

A.H. 423. Advanced Stock Judging (2) PROFESSOR W. L. HENNING

A.H. 424. Animal Husbandry Survey (1)
PROFESSOR F. L. BENTLEY AND STAFF

A.H. 426. Livestock Markets and Marketing (3)
PROFESSORS F. L. BENTLEY, W. L. HENNING

A.H. 428. Advanced Animal Nutrition (3)
PROFESSOR F. L. BENTLEY AND STAFF

ANIMAL NUTRITION

PROFESSOR RAYMOND W. SWIFT, M.S., Ph.D.
Head of the Department

An. Nutr. 500. Research in Animal Nutrition (Credit to be arranged) Participation in the research program of the Department of Animal Nutrition and independent investigation. The available facilities make it possible to accommodate only a small number of students.

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

An. Nutr. 401. Physiology of Nutrition (3) PROFESSOR ALEX BLACK
An. Nutr. 402. Physiology of Nutrition (3) PROFESSOR R. W. SWIFT

ARCHITECTURAL ENGINEERING

Consult PROFESSOR LOUIS A. RICHARDSON, M.S.

A.E. 502. Architectural Engineering (3-8) Advanced structural design in steel and reinforced concrete. Lectures and class criticism. Practicum and seminar.
PROFESSOR L. A. RICHARDSON AND STAFF

A.E. 503. Architectural Engineering (4-8) A continuation of A.E. 502 in which problems of wind bracing in tall buildings, rigid frames, and heavy-framed construction are studied. Practicum and seminar.
PROFESSOR R. B. FOX

A.E. 504. Architectural Engineering (4-8) Statically indeterminate stresses in steel and reinforced concrete buildings; area moment, slope deflection, and moment distribution methods. Recitation and seminar.
PROFESSOR L. A. RICHARDSON AND STAFF

A.E. 505. Architectural Engineering (4-8) A continuation of A.E. 504. Recitation and seminar. PROFESSOR J. E. SPAGNUOLO

A.E. 506. Architectural Engineering Research (1-15) The presentation of an assigned problem under the guidance of an instructor.
PROFESSORS L. A. RICHARDSON, R. B. FOX, J. E. SPAGNUOLO

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

A.E. 404. Architectural Engineering (4) Fee 50c. PROFESSOR R. B. FOX
A.E. 405. Architectural Engineering (4) PROFESSOR L. A. RICHARDSON
A.E. 406. Architectural Engineering (4) Fee 50c. PROFESSOR R. B. FOX
A.E. 407. Architectural Engineering (3) Fee 50c.
PROFESSOR L. A. RICHARDSON
A.E. 410. Architectural Engineering (3) PROFESSOR L. A. RICHARDSON
A.E. 411. Architectural Engineering (3) PROFESSOR R. B. FOX

ARCHITECTURE

PROFESSOR MILTON S. OSBORNE, M.S.
Head of the Department

Arch. 501. Architectural Design (4-8) Problems in advanced planning and design, including study of group composition. Practicum and seminar.
PROFESSOR M. S. OSBORNE AND STAFF

Arch. 502. Architectural Research (2-12) The prosecution of assigned problems under the guidance of an instructor.
PROFESSOR M. S. OSBORNE AND STAFF

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Arch. 406. Advanced Architectural Design (7) Fee $1.
PROFESSOR M. S. OSBORNE AND STAFF

Arch. 407. Advanced Architectural Design (7) Fee $1.
PROFESSOR M. S. OSBORNE AND STAFF

Arch. 410. Advanced Architectural Design (2-12)
PROFFESOR M. S. OSBORNE AND STAFF

Arch. 420. Post-Renaissance Architecture (3)
PROFESSORS H. E. DICKSON, F. E. HYSLOP JR., P. F. NORTON

Arch. 421. Contemporary Architecture (3)
PROFESSORS H. E. DICKSON, F. E. HYSLOP JR., P. F. NORTON

ART

PROFESSOR MILTON S. OSBORNE, M.S.
Head of the Department of Architecture

(See also courses in Art Education below)

Art 500. Art Research (2-6) The prosecution of assigned problems under the guidance of an instructor. PROFESSOR H. S. GALBRAITH

Art 501. Italian Painting (2-4) Investigations in the field of early Italian painting. Seminar, written reports. PROFESSOR H. E. DICKSON

Art 502. Medieval Sculpture (2-4) Sculpture of Italy and France from ninth to thirteenth centuries. Seminar, written reports. PROFESSOR H. E. DICKSON

Art 503. Art History Research (3-8) Original study in some phase of the history of art; investigation of approved subjects. Seminar, written reports. drawing. Prerequisite: a 3-credit 400 course in art history.
PROFESSOR H. E. DICKSON AND STAFF

Art 504. Seminar: Art Literature and Iconography (2-4) Required for degree candidates majoring in art history. Introduction to principles of research in fine arts, designed to familiarize the student with fundamental tools of scholarship in history of art; problems of bibliography and material of iconography; frequent reports on assigned topics provide actual practice in original research. Prerequisite: a minimum of 12 credits in history of art. Conference. PROFESSOR H. E. DICKSON AND STAFF

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Art 400S. Oil Painting: Landscape, Still-Life, and Figure (3-9)

Art 403S. Comparative History and Appreciation of Art (3) Fee $1.
PROFESSOR H. E. DICKSON

Art 404S. Comparative History and Appreciation of Art (3) Fee $1.
PROFESSOR H. E. DICKSON

Art 410. Water-Color Painting: Landscape, Still-Life, and Figure (3)
PROFESSOR A. W. CASE

Art 442. Art of the Middle Ages and Renaissance in Italy (3)
PROFESSOR H. E. DICKSON

Art 443. Art in America (3) PROFESSOR H. E. DICKSON

Art 444. Art in Northern Europe (3) PROFESSOR F. E. HYSLOP JR.

Art 446. Ancient Art (3) PROFESSOR H. E. DICKSON

Art 447. Latin-American Art (3)
PROFESSORS H. E. DICKSON, F. E. HYSLOP JR., P. F. NORTON

Art 451. Modern Painting (3) PROFESSOR F. E. HYSLOP JR.

Art 490. Life Drawing (3) Fee $3. PROFESSOR A. W. CASE

ART EDUCATION

Consult PROFESSOR VIKTOR LOWENFELD

Art Ed. 514. Functional Relationships in Crafts (3) Relationships of material design and purpose in crafts discussed by means of outstanding products of different materials, periods, and cultures. The student will concentrate on one particular field. Prerequisite: 6 credits in crafts or 3 in design and 3 in advanced crafts. Lecture 2 hours, practicum 2 hours.

Art Ed. 534. Creative Art Activity for the Handicapped (3) Specific methods for development of creative art activity with the physically, mentally, emotionally, and socially handicapped, and the adjustive effect upon them. Prerequisite: 6 credits in art education or 6 credits in special education. Lecture 3 hours. PROFESSOR VIKTOR LOWENFELD

Art. Ed. 586. Research in Art Education (3-9) Current experiments in art education; methods for evaluating art activities as they contribute to the growth of the child. Required of students working for a master's degree in art education. PROFESSOR VIKTOR LOWENFELD

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

Art Ed. 402. Methods of Teaching Drawing in the Grades (2-3) Fee $2.

Art Ed. 404. Methods of Graphics and Illustrations (3) Fee $3.

Art Ed. 414. Advanced Crafts for Teachers (3-6) Fee $1 per credit.
PROFESSOR SYBIL EMERSON

Art Ed. 434. Art Appreciation in the Educational Program (2-3)

Art Ed. 434b. Art in the Elementary School (2-3) Fee $3.
PROFESSOR VIKTOR LOWENFELD

Art Ed. 434c. Art in the Secondary School (2-3) Fee $3.
PROFESSOR VIKTOR LOWENFELD

Art Ed. 434d. Art Supervision (3) PROFESSOR VIKTOR LOWENFELD

Art Ed. 486, 486X. Current Problems in Art Education (2-3)
PROFESSOR VIKTOR LOWENFELD

Art Ed. 487. Mural Painting in Schools (3) Fee $3.
PROFESSOR VIKTOR LOWENFELD

Art Ed. 488. Advanced Mural Painting in Schools (3) Fee $3.
PROFESSOR VIKTOR LOWENFELD

BACTERIOLOGY

PROFESSOR ROBERT W. STONE, Ph.D.

Head of the Department

Bact. 504. Dairy Bacteriology Problems (2-15) Assigned problems dealing with dairy barn sanitation, bacteriology as related to methods of producing milk, and the role of bacteria in dairy manufacture and dairy products. Prerequisite: a minimum of 12 credits in bacteriology, also courses in allied subjects. Fee $3 per credit. PROFESSOR J. J. REID

Bact. 505. Pathogenic Bacteriology and Immunology (2-15) The morphological, cultural, and immunological characteristics of pathogenic bacteria. Different phases of pathological bacteriology are selected for the student to the number of credits elected. Prerequisite: a minimum of 12 credits in bacteriology with suitable courses in allied subjects. Fee $3 per credit.
PROFESSOR M. A. FARRELL AND STAFF

Bact. 506. Research (2-15) Work on an assigned problem in one of the fields of bacteriology for students who are doing their major work in this subject for the master's or doctor's degree; the planning and conducting of a meritorious research. Prerequisite: a minimum of 12 credits in bacteriology, also courses in allied subjects bearing on the problem selected. Fee $3 per credit.
PROFESSOR M. A. FARRELL AND STAFF

Bact. 507. Bacteriological Seminar (1) Conducted on the order of a journal club in which the various graduate students give complete reports on various current fields of research. May be repeated, one additional credit for each semester's work. Prerequisites: Bact. 8, 412.
PROFESSOR J. J. REID AND STAFF

Bact. 508. Physiology of Bacteria (2) Intricate metabolic processes of bacteria as influenced by their environment; the mechanism of fermentation and respiration of microorganisms. Prerequisite: Bact. 412. Lecture 2 hours.
PROFESSORS M. A. FARRELL, J. J. REID

Bact. 508a. Laboratory in Physiology of Bacteria (2) Laboratory work to accompany the lectures given in Bact. 508. Prerequisite: Bact. 412. Practicum 6 hours. Fee $12. PROFESSORS M. A. FARRELL, J. J. REID

Bact. 509. Fermentation (2) The chemical action of microorganisms on their environment; theories of carbohydrate breakdown and the application of these theories to industrial and agricultural fermentations. Prerequisites: Bact. 1, 2, Chem. 31. Lecture 2 hours. PROFESSOR R. W. STONE

Bact. 510. Methods and Analyses in Bacterial Fermentation (2) Laboratory procedures and problems in fermentation to accompany Bact. 509. Prerequisites: Bact. 1, 2, Chem. 31. Practicum 6 hours. Fee $12.
PROFESSOR R. W. STONE

Bact. 511. Bacteriological Literature (2-4) Assigned reading and conferences dealing with a student's research problem. May be taken only in those instances where a student is not scheduling Bact. 504, 505, or 506. Discussion and written reports. Prerequisite: 12 credits in bacteriology.
PROFESSOR M. A. FARRELL AND STAFF

Bact. 512. Laboratory in Advanced Bacteriological Techniques (2-6) Certain techniques and tools used in research investigations: the Chambers micromanipulator, the Warburg apparatus, and certain techniques employed in

respiration, fermentation, and serological investigations. May be repeated with credit. Prerequisite: 12 credits of bacteriology. Practicum 3 hours per credit. Fee $3 per credit. PROFESSOR M. A. FARRELL AND STAFF

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Bact. 407. Bacteriology Problems (2-9) Fee $3 per credit. PROFESSOR M. A. FARRELL AND STAFF

Bact. 410. Immunology and Serology (4) Fee $15. PROFESSOR D. W. MCKINSTRY

Bact. 411. Bacteriological Survey (1) PROFESSOR M. A. FARRELL

Bact. 412. Advanced Bacteriology (4) Fee $12. PROFESSOR M. A. FARRELL

Bact. 413. Soil Bacteriology (4) Fee $12. PROFESSOR J. V. BECK

Bact. 414. Food Bacteriology (4) Fee $12. PROFESSOR JOHN C. GAREY

Bact. 415. Virology (4) Fee $15. PROFESSOR D. W. MCKINSTRY

BOTANY

PROFESSOR FRANK D. KERN, M.S., Ph.D., D.Sc.
Head of the Department

Bot. 501. The Physiology of the Fungi (3) The metabolism of the fungi, general and special nutrition, chemical composition, enzymes, spore germination, toxic and stimulating agencies, growth and tropism, etc. Prerequisites: Bot. 406, 419, and, preferably, Chem. 32. Lectures and practicum. Fee $3.

Bot. 502. The Ascomycetes (3) The morphology, life histories, taxonomy, and physiology of the ascomycetous fungi. Prerequisite: Bot. 419. Lectures and practicum. Fee $3.

Bot. 503. The Rusts and Smuts (3) The morphology, life histories, taxonomy, and phylogeny of the rusts and smuts. Prerequisite: Bot. 419. Lectures and practicum. Fee $3. PROFESSOR F. D. KERN

Bot. 504. The Higher Basidiomycetes (3) The structures, habits, taxonomy, and relationships of the various groups of higher basidiomycetes. Prerequisite: Bot. 419. Lectures and practicum. Fee $3.

Bot. 505. Cytology and Cytogenetics (3) Components of the protoplast, chromosome structure and cell division; meiosis and syngamy in the life cycle; alternation of chromosome phases in organisms; heteroploidy and chromosome aberrations such as chromosome fragments, inversions, deletions, duplications, transpositions, and translocations and their genetic implications. The role of chromosomes in heredity and breeding. Prerequisites: Bot. 22 or 32, 421. Fee $6. PROFESSOR J. B. HILL

Bot. 506. Comparative Anatomy of Vascular Plants (3) The special anatomical features of pteridophytes, gymnosperms, and angiosperms. Prerequisites: Bot. 7, 415, 416. Lectures and practicum. Fee $3. PROFESSOR D. A. KRIBS

Bot. 507. Variation and Selection (3) Variation and the results of selection in pure lines and clones involving the collection, interpretation, and analysis of data by biometrical means. Prerequisites: Bot. 22 or 32, 423. Lectures and practicum. Fee $3. PROFESSOR J. P. KELLY

Bot. 508. Problems of Heredity (2-6) Problems in genetics selected to suit the needs and accomplishments of individual students. Prerequisites: Bot. 22 or 32, 422 or 423. Fee $1 per credit. PROFESSORS J. B. HILL, J. P. KELLY

Bot. 509. The Physiology of Parisitism (3) The conditions and processes of infection, diseases, and death in plants as caused by parasitic organisms. Prerequisite: Bot. 10, 11, or 419. Lectures and practicum. Fee $3.
PROFESSOR H. W. THURSTON

Bot. 510. Plant Pathological Problems (3-6) Special diseases or disease groups, such as bacterial or mosaic diseases, etc. Prerequisite: Bot. 10 or 11. Conferences and practicum. Fee $1 per credit. PROFESSOR H. W. THURSTON

Bot. 511. Growth and Movement (2-4) The physiology of growth with special reference to the influence of external and internal factors upon growth, development, and movement of plants. Prerequisite: Bot. 406. Lecture 2 hours, practicum 4 hours. Fee $5 if laboratory work is taken. PROFESSOR H. W. POPP

Bot. 512. Plant Metabolism (2-4) The physiological processes involved in the metabolism of plants; alternates with Bot. 511. Prerequisite: Bot. 406. Lecture 2 hours, practicum 4 hours. Fee $5 if laboratory work is taken.
PROFESSOR H. W. POPP

Bot. 514. Cytotaxonomy (2) Relationships within and between the groups of plants as indicated by their cytological features; the origin and relationships of chromosome numbers, homoploidy and heteroploidy, hybridization, apomixis and related phenomena, and the role of these in geographic distribution and speciation in the plant kingdom. Prerequisites: Bot. 414, 505. Lecture 2 hours. PROFESSOR H. A. WAHL

Bot. 515. Disease Resistance and Its Inheritance (2-4) The nature and etiology of plant diseases; disease resistance as a principle of control; ecology of plant diseases; concepts of disease resistance and escape; stability of disease resistance; economics of control; special problems. Prerequisites: Bot. 22 or 32, 10. Lecture 2 hours, practicum 3 to 6 hours. Fee $1 per credit.
PROFESSORS C. C. WERNHAM, W. R. MILLS

Bot. 517. The Fungi Imperfecti (3) The morphology, life histories, and taxonomy of the fungi imperfecti. Prerequisite: Bot. 419. Lectures and practicum. Fee $3.

Bot. 518. Botanical Research (1-15 per semester) The prosecution of an assigned problem under the guidance of an instructor.
PROFESSOR F. D. KERN AND STAFF

Bot. 527aS, 527bS. Foundations of Plant Biology (3 per course) Cellular structure and organization with consideration of the physiological and reproductive processes in so far as these form the basis of plant life. Bot. 527a and 527b will be offered in alternate years. In the former emphasis will be on cellular structure and physiology, in the latter on racial preservation and development and relationship of plant groups. Prerequisite: general biology or general botany courses. Lecture 2 hours, practicum 6 hours. Fee $2.50 for each course. PROFESSOR F. D. KERN

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Bot. 406. Plant Physiology (4) Fee $6. PROFESSOR H. W. POPP

Bot. 407. Plant Anatomy (3) Fee $4. PROFESSOR D. A. KRIBS

Bot. 408. General Plant Pathology (3) Fee $6.
PROFESSOR H. W. THURSTON

Bot. 409S. Plant Ecology (3)

Bot. 412. Advanced Forest Pathology (3) Fee $4.

Bot. 414aS. Systematic Botany (3) Fee $1. PROFESSOR H. A. WAHL

Bot. 414bS. Systematic Botany (3) Fee $1. PROFESSOR H. A. WAHL

Bot. 415. Morphology of the Algae (3) Fee $4. PROFESSOR J. B. HILL

Bot. 416. Morphology of the Bryophytes and Pteridophytes (3) Fee $4.
PROFESSOR J. B. HILL

Bot. 418. Botanical Problems (1-6) PROFESSOR F. D. KERN AND STAFF

Bot. 419. Mycology (3) Fee $4.

Bot. 420. Morphology of the Seed Plants (3) Fee $4.
PROFESSOR A. R. GROVE

Bot. 421. Botanical Technique (3) Fee $6. PROFESSOR J. B. HILL

Bot. 422. Genetic Phenomena (3) PROFESSOR J. B. HILL

Bot. 423. Advanced Genetics (2-6) Fee $4.
PROFESSORS J. P. KELLY, J. B. HILL

Bot. 424. Commercial Tropical Woods (3) Fee $4. PROFESSOR D. A. KRIBS

Bot. 432S. Genetics, Eugenics, and Evolution (3)

CERAMICS

PROFESSOR EDWARD C. HENRY, M.S., Cer.E., Ph.D.

Chief of the Division

Cer. 500. Ceramics Seminar (1 per semester) Conferences, reading, and reports. Required of all graduate students in ceramics. Prerequisites: Chem. 41, Phys. 285. Lecture 1 hour. PROFESSOR E. C. HENRY AND STAFF

Cer. 501. Ceramics Research (1-15 per semester) Laboratory study on special ceramic problems. Practicum 3 to 45 hours. Fee $2 per credit.
PROFESSOR E. C. HENRY AND STAFF

Cer. 502. Heat Treatment of Ceramic Materials (2-5)
PROFESSOR C. G. DODD

Cer. 503. Constitution of Glass (2-4) An advanced course on glass dealing with the latest developments in the structure of viscous liquids and transparent amorphous solids. Prerequisite: Cer. 415. Lecture 2 hours.
PROFESSORS WOLDEMAR WEYL, ALFRED BASTRESS

Cer. 504. Research Instruments and Equipment (2) Application of fundamental laws and principles in research instruments; care, adjustment, and effective use of instruments and equipment (demonstrations). Prerequisite: Cer. 411. Lecture 2 hours. PROFESSOR E. C. HENRY AND STAFF

Cer. 505. Glass Technology Research (1-15 per semester) Laboratory studies on special problems concerning the properties, constitution, and manufacture of glass. Prerequisite: Cer. 415. Practicum 3 to 45 hours. Fee $2 per credit. PROFESSOR WOLDEMAR WEYL AND STAFF

Cer. 506. Glass Technology Seminar (1-6) Group discussion of special advanced topics concerning the properties and manufacture of glass. Prerequisite: Cer. 415. Lecture 1 to 6 hours. PROFESSOR ALFRED BASTRESS

Cer. 507. Coloring and Decolorizing Glass (1) Physical-chemical considerations of the various coloring oxides; oxidation-reduction equilibria pertaining to coloring and decolorizing of glass. Prerequisite: Cer. 415. Lecture 1 hour. PROFESSOR WOLDEMAR WEYL

Cer. 508. Colloidal Behavior of Industrial Clays, Muds, and Slimes (2) Principles of colloidal activity applied to the control of the properties of clay slips, drilling fluids, and similar suspensions; swelling of shales and bentonites; colloidal phenomena associated with the beneficiation and use of industrial minerals. (In co-operation with the Petroleum and Natural Gas staff.) Prerequisite: Chem. 41. Lecture 2 hours. PROFESSOR E. C. HENRY

Cer. 509. Silicate Systems (3) Various binary and ternary silicate and oxide systems; reactions in the solid and liquid state; chemical and mineralogical aspects of the manufacture, use, and behavior of refractories; slags as they relate to refractories and to metal melts. Prerequisite: Chem. 41. Lecture 3 hours. PROFESSOR C. G. DODD

Cer. 510. Ceramic Problems (1-6 per semester) Individual study of an advanced nature on a problem in some branch of ceramics, including review of the pertinent literature and a full report of the results of the work. Prerequisite: Cer. 411. Practicum 3 to 18 hours. Fee $2 per credit.
PROFESSOR E. C. HENRY AND STAFF

Cer. 511. Selected Topics in Ceramics (1-3 per semester) Intensive group study of special subjects, such as diffusion in solids, viscosity, and kinetics of ceramic processes. Prerequisites: Chem. 41, Phys. 285. Recitation 1 to 3 hours. PROFESSOR E. C. HENRY AND STAFF

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Cer. 400. Special Topics (1-2)
Cer. 401. Ceramic Bodies and Glazes (3) Fee $10. PROFESSOR E. C. HENRY
Cer. 402. Principles of Ceramic Engineering (3) PROFESSOR E. C. HENRY
Cer. 403. Ceramic Engineering Processes and Equipment (3)
PROFESSOR E. C. HENRY
Cer. 404. Ceramics Seminar (1) PROFESSOR E. C. HENRY AND STAFF
Cer. 405. Ceramic Research and Design (3) Fee $10.
PROFESSOR E. C. HENRY AND STAFF
Cer. 411. Theory of Ceramic Processes (3) PROFESSOR C. G. DODD
Cer. 413. Ceramic Petrography (3) Fee $10. PROFESSOR C. G. DODD
Cer. 415. Glass and Enamels (3) PROFESSOR ALFRED BASTRESS
Cer. 416. Advanced Glass Technology (3) Fee $5.
PROFESSOR WOLDEMAR WEYL
Cer. 420. Refractories (2) Fee $5. PROFESSOR C. G. DODD

CHEMICAL ENGINEERING

Consult PROFESSOR DONALD S. CRYDER, M.S., D.Sc.

Chem. Eng. 500. Seminar in Chemical Engineering (1) Required of all graduate students.

Chem. Eng. 510. Advanced Heat Transfer I (3) The physical and chemical factors controlling the rate of heat transfer under conditions of steady flow. Lecture 3 hours. PROFESSOR D. S. CRYDER

Chem. Eng. 511. Advanced Heat Transfer II (3) Flow of heat under varying temperature conditions. Lecture 3 hours. PROFESSOR D. S. CRYDER

Chem. Eng. 513. Diffusion (2) The factors controlling diffusional operations such as absorption, extraction, humidification, etc. Lecture 2 hours. PROFESSOR F. L. CARNAHAN

Chem. Eng. 515. Distillation (3) Commercial distillation, equilibrium diagrams, vapor composition, stills and rectifying and stripping columns. Lecture 3 hours. PROFESSOR F. L. CARNAHAN

Chem. Eng. 516. Economic Balance (3) Problem work on the design of chemical engineering equipment from the economic standpoint. Lecture 3 hours. PROFESSOR M. R. CANNON

Chem. Eng. 518. Chemical Engineering Design (3) Complicated examples are discussed and worked out. Several different unit operations will be combined for the design of a complete installation. Lecture 3 hours. PROFESSOR D. S. CRYDER

Chem. Eng. 519. Chemistry of Combustion (3) The physical and chemical characteristics of combustion and their influence on plant scale equipment. Lecture 3 hours. PROFESSOR D. S. CRYDER

Chem. Eng. 524. Chemical Engineering, Application of Thermodynamics (3) Elements of thermochemistry and thermodynamics of most importance in chemical engineering. Lecture 3 hours. PROFESSOR M. R. CANNON

***Chem. Eng. 580. Research in Petroleum Refining (3-15)** Fee $2 per credit, with a minimum of $10 per semester.
PROFESSORS M. R. FENSKE, F. L. CARNAHAN, DOROTHY QUIGGLE

†**Chem. Eng. 599. Research in Chemical Engineering (1-15)** Fee $2 per credit, with a minimum of $10.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Chem. Eng. 402. Chemical Engineering (4) PROFESSOR F. L. CARNAHAN

Chem. Eng. 403. Chemical Engineering (4) PROFESSOR F. L. CARNAHAN

Chem. Eng. 421. Petroleum Products (4) Fee $7, breakage ticket $3.
PROFESSORS F. L. CARNAHAN, D. S. CRYDER, M. R. CANNON

Chem. Eng. 422. Motor Fuels (2) PROFESSOR F. L. CARNAHAN

Chem. Eng. 423. Lubricants (2) PROFESSOR F. L. CARNAHAN

Chem. Eng. 425. Standard Tests of Petroleum and Its Products (1) Fee $3, breakage ticket $2. PROFESSORS F. L. CARNAHAN, D. S. CRYDER, M. R. CANNON

CHEMISTRY

PROFESSOR GROVER C. CHANDLEE, M.A., M.S., Ph.D.
Head of the Department

Chem. 500. Seminar in Inorganic, Micro, and Textile Chemistry (1)

*Credits to be arranged, 3-15 per semester.
†Credits to be arranged, 1-15 per semester.

Chem. 501. Seminar in Physical Chemistry (1)

Chem. 502. Seminar in Organic Chemistry (1)

Chem. 515. Inorganic Chemistry (2) Adapted to the need of those doing research work in inorganic chemistry. Lecture 2 hours.
PROFESSOR G. C. CHANDLEE

Chem. 525. Theories Underlying Analytical Chemistry (2) Lecture 2 hours.
PROFESSOR G. C. CHANDLEE

Chem. 531. Special Topics in Organic Chemistry (3) May be taken for credit for four successive semesters. Lecture 3 hours.

Chem. 532. Organic Nitrogen Compounds (3) The chemistry of the organic compounds containing nitrogen in its various states of combination; esters of oxyacids of nitrogen, amines, amides, iminoesters, hydroxylamines, hydroxamic acids, oxines, nitrosocompounds, diazo and azocompounds, pseudobases; stereochemistry of nitrogen, application of modern theories of molecular structure to the constitution of organic nitrogen compounds. Lecture 3 hours. PROFESSOR J. G. ASTON

Chem. 533. Terpenes (3) The terpenes and their more important derivatives with special reference to the applications of the principles of aliphatic chemistry. Lecture 3 hours.

Chem. 534. Theoretical Organic Chemistry (3) Application of modern theories of atomic and molecular structure to organic chemistry; resonance in organic compounds; interpretation of physical properties and application to structure proof; theory of rates of chemical reactions as applied to organic chemistry—representative examples; equilibrium properties as a limiting consideration. Lecture 3 hours. PROFESSOR J. G. ASTON

Chem. 535. Organic Chemistry (3) Adapted to the needs of those doing research work in organic chemistry. Lecture 3 hours. PROFESSOR H. D. ZOOK

Chem. 536. Organic Chemistry (3) A continuation of Chem. 535. Lecture 3 hours. PROFESSOR H. D. ZOOK

Chem. 538. Organic Chemistry (3) A survey of organic chemistry arranged primarily for graduate students majoring in fields other than organic chemistry. Lecture 3 hours. PROFESSOR C. I. NOLL

Chem. 539. Stereochemistry (3) A comprehensive treatment of the principles of stereochemistry as applied to organic compounds. Lecture 3 hours.
PROFESSOR T. S. OAKWOOD

Chem. 541. Phase Rule (3) The phase rule and its applications. Lecture 3 hours. Given 1948-49 and in alternate years thereafter.
PROFESSOR A. J. CURRIER

Chem. 542. Colloids (3) The physics and chemistry of surfaces and their resulting colloid properties. Methods of preparing colloids. Lecture 3 hours.
PROFESSOR W. P. DAVEY

Chem. 543. Rheology of Colloids (3) A continuation of Chem. 542. Rheology, especially as applied to colloids and similar substances. Lecture 3 hours.
PROFESSOR W. P. DAVEY

Chem. 544. Chemical Thermodynamics (3) Development of thermodynamic theory with special reference to common physical changes and chemical reactions. Prerequisite: Chem. 441 or 562. Lecture 3 hours.
PROFESSOR J. G. ASTON

Chem. 545. Chemical Thermodynamics and Introductory Statistical Mechanics (3) A continuation of Chem. 544 including the calculation of thermodynamic properties from molecular and spectroscopic data. Prerequisite: Chem. 544. Lecture 3 hours. PROFESSOR J. G. ASTON

Chem. 546. Quantum Chemistry (3) Theory of energy levels in atoms and molecules from the standpoint of wave mechanics with specific emphasis on the portion of the subject applying to common chemical systems. Prerequisite: Chem. 441 or 562. Lecture 3 hours. Given alternate years only. PROFESSOR J. G. ASTON

Chem. 547. Statistical Mechanics (3) The properties of matter at equilibrium developed on the basis of the energy levels of molecules and statistical mechanical theory; calculation of heat capacity, entropy and free energy of gases, crystals, etc. Prerequisite: Chem. 546. Lecture 3 hours. Given alternate years only. PROFESSOR J. G. ASTON

Chem. 548. Catalysis (3) The theory of catalysis and its application to industry. Lecture 3 hours. Given 1949-50 and in alternate years thereafter. PROFESSOR A. J. CURRIER

***Chem. 550. Research in the Chemistry of Textiles (1-15)** Fee $2 per credit, with a minimum of $10. PROFESSOR P. B. MACK

Chem. 561. Chemical Principles (3) A mathematical treatment of the classical principles of chemistry; their application to problems. Required of all graduate students. Prerequisites: Chem. 41, Math. 11, Phys. 285. A course in organic chemistry is recommended. Lecture 3 hours. PROFESSOR J. G. ASTON

Chem. 562. Chemical Principles (3) A continuation of Chem. 561. Required of all graduate students. Lecture 3 hours. PROFESSOR J. G. ASTON

Chem. 563. Chemical Kinetics (3) The theory and measurement of the rates of chemical reactions; the mechanism of chemical reactions. Lecture 3 hours. PROFESSOR J. H. SIMONS

Chem. 564. Chemical Kinetics (3) A continuation of Chem. 563 but including the theory and measurement of photochemical reactions. Lecture 3 hours. PROFESSOR J. H. SIMONS

Chem. 565. Atomic and Molecular Structure (3) The structure of chemical species and the correlation of experimentally determined properties by structural theory. Lecture 3 hours. PROFESSOR J. H. SIMONS

Chem. 566. Atomic and Molecular Structure (3) A continuation of Chem. 565. Lecture 3 hours. PROFESSOR J. H. SIMONS

Chem. 567. Advanced Theoretical Chemistry (3) Modern and current theories of the properties of chemical substances and their applications to chemical problems; the construction of chemical theory. Lecture 3 hours. PROFESSSOR J. H. SIMONS

Chem. 568. Advanced Theoretical Chemistry (3) A continuation of Chem. 567. Lecture 3 hours. PROFESSOR J. H. SIMONS

***Chem. 580. Research in Petroleum Refining (1-15)** Fee $2 per credit, with a minimum of $10. PROFESSOR M. R. FENSKE

***Chem. 599. Research in Chemistry (1-15)** Fee $2 per credit, with a minimum of $10.

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*Credits to be arranged, 1-15 per semester.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Chem. 400. Chemical Literature (1) MISS M. L. JACKSON

Chem. 426. Advanced Qualitative and Quantitative Analysis (5) Fee $10, breakage ticket $10. PROFESSOR T. W. MASON

Chem. 434. Quantitative Organic Analysis (3-5) Fee $2, breakage ticket $10 for 3 credits; fee $4, breakage ticket $12 for 4 credits; fee $8, breakage ticket $12 for 5 credits. PROFESSOR R. W. HIGGINS

Chem. 435. Organic Preparations and Laboratory Methods (3-5) Fee $2, breakage ticket $10 for 3 credits; fee $4, breakage ticket $12 for 4 credits; fee $8, breakage ticket $12 for 5 credits. PROFESSOR R. W. HIGGINS

Chem. 436. Organic Chemistry of Natural Products (3) PROFESSOR J. G. ASTON

Chem. 437. Qualitative Organic Analysis (3) Fee $6, breakage ticket $4. PROFESSOR J. H. OLEWINE

Chem. 438. Introduction to Research in Organic Chemistry (2-5) Fee $4, breakage ticket $10 for 2 credits; fee $6, breakage ticket $10 for 3 credits; fee $8, breakage ticket $12 for 4 credits; fee $10, breakage ticket $12 for 5 credits. PROFESSOR R. W. HIGGINS

Chem. 440. Advanced Physical Chemistry (3) PROFESSOR A. W. HUTCHISON

Chem. 441. Advanced Physical Chemistry (3) PROFESSOR A. W. HUTCHISON

Chem. 448. Colloid Chemistry (3) Fee $7, breakage ticket $3. PROFESSOR A. W. HUTCHISON

Chem. 453a-h. Recent Advances in Textile Chemistry (1-8)

Chem. 470. Chemical Microscopy (3) Fee $8, breakage ticket $2. PROFESSOR M. L. WILLARD

Chem. 471. Advanced Chemical Microscopy (3) Fee $8, breakage ticket $2. PROFESSOR M. L. WILLARD

Chem. 472. Quantitative Organic Microanalysis (3) Fee $8, breakage ticket $2. PROFESSOR G. H. FLEMING

Chem. 473. Textile Microscopy (3) Fee $8, breakage ticket $2. PROFESSOR M. L. WILLARD

Chem. 474. Quantitative Organic Microanalysis (3) Fee $8, breakage ticket $2. PROFESSOR G. H. FLEMING

Chem. 475. Introduction to Chemical Spectroscopy (3) Fee $8, breakage ticket $2. PROFESSOR M. L. WILLARD

Chem. 476. Microscopic Microtechnique (3) Fee $8, breakage ticket $2. PROFESSOR M. L. WILLARD

Chem. 477. Paper Microscopy (3) Fee $8, breakage ticket $2. PROFESSOR M. L. WILLARD

†**Chem. 490. Organic Chemistry (5)** Fee $6, breakage ticket $4. PROFESSOR J. H. OLEWINE

†**Chem. 491. Organic Chemistry (5)** Fee $8, breakage ticket $12. PROFESSOR J. H. OLEWINE

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†Candidates for the M.Ed. degree.

†**Chem. 492a. Advanced General Chemistry** (3) Fee $7, breakage ticket $3.
PROFESSOR A. J. CURRIER

†**Chem. 492b. Advanced General Chemistry** (3) Fee $7, breakage ticket $3.
PROFESSOR A. J. CURRIER

†**Chem. 495. Experimental Problems in Chemistry** (3 or 6) Fee $2, breakage ticket $10 for 3 credits; fee $8, breakage ticket $12 for 6 credits.
PROFESSOR A. J. CURRIER

†**Chem. 496. General Physical Chemistry** (3) PROFESSOR A. W. HUTCHISON

†**Chem. 497. General Physical Chemistry** (2) PROFESSOR A. W. HUTCHISON

†**Chem. 498. Physicochemical Measurements** (1) Fee $14, breakage ticket $6.
PROFESSOR A. W. HUTCHISON

†**Chem. 499. Physicochemical Measurements** (1) Fee $14, breakage ticket $6.
PROFESSOR A. W. HUTCHISON

CIVIL ENGINEERING

PROFESSOR BENJAMIN A. WHISLER, M.S., Sc.D.
Head of the Department

C. E. 500. Seminar in Civil Engineering (1-6) Reports on researches and special topics. Course may be continued in subsequent semesters.

C. E. 521. Transport Planning and Design (2-6) The functional planning and design of transportation facilities. Basic principles and engineering techniques are applied to selected problems in airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 421, 422, 461, or 481.
PROFESSORS J. E. KAULFUSS, J. S. LEISTER

C. E. 522. Transport Operation and Maintenance (2-6) Engineering problems in the operation, maintenance, and administration of transportation facilities. Problems are selected from airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C. E. 421, 422, 461, or 481.
PROFESSORS J. E. KAULFUSS, J. S. LEISTER

C. E. 540. Advanced Structural Analysis (2-4) Geometry of flexure; deflections; analysis of continuous beams, rigid frames, arches; influence lines. Prerequisite: C. E. 40. Lecture 3 hours.
PROFESSORS R. E. MINSHALL, A. A. BRIELMAIER

C. E. 541. Advanced Structural Analysis (2-4) Truss deflections, analysis of trusses with redundant members, continuous trusses, framed arches; influence lines; secondary stresses; wind stresses; space framework; suspension bridges. Prerequisite: C. E. 40.
PROFESSORS R. E. MINSHALL, A. A. BRIELMAIER

C. E. 542. Foundations and Soil Mechanics (2-5) Physical tests, classification, stress distribution, consolidation, shearing resistance, seepage, and permeability of soils, with applications to foundation design, stability of embankment, retaining walls, etc.; foundation construction. Prerequisite: Mchs. 13. Lecture 1 hour minimum, practicum 3 hours minimum.
PROFESSORS R. E. MINSHALL, C. A. EDER

†Candidates for the M.Ed. degree.

C. E. 543. Structural Engineering Projects (3-10) Investigation or design projects in concrete, soil mechanics, photoelasticity, analysis, etc. Prerequisite or concurrent: C. E. 441, 442.
PROFESSORS R. E. MINSHALL, A. A. BRIELMAIER

C. E. 544. Advanced Structural Design (2-4) Plain and reinforced concrete design as applied to buildings, bridges, retaining walls, domes, tanks, and dams; prestressed concrete. Prerequisite: C. E. 442.
PROFESSORS R. E. MINSHALL, A. A. BRIELMAIER

C. E. 545. Advanced Structural Design (2-4) Structural steel design as applied to riveted and welded girders, trusses, rigid frames, wind connections; timber design. Prerequisite: C. E. 41. Lecture 3 hours.
PROFESSORS R. E. MINSHALL, A. A. BRIELMAIER

C. E. 546. Structural Data as Basis for Design Specifications (2) Critical study of experimental data and design specifications for steel and reinforced concrete. Prerequisites: C. E. 41, 42. Lecture 2 hours.
PROFESSORS R. E. MINSHALL, A. A. BRIELMAIER

C. E. 550. Engineering Construction (2-4) Construction methods applied to foundations, buildings, bridges, and other civil engineering construction work. Prerequisites: C. E. 41, 42.

C. E. 560. Theory of Models (2) The theory of models with special emphasis on laboratory methods in problems in hydraulics and fluid mechanics.
PROFESSORS L. S. RHODES, J. M. ROBERTSON

C. E. 561. Hydrologic Investigations (2-4) Application of hydrologic principles and design techniques to a project selected from such fields as flood control, water power, and water supply. Prerequisite: C. E. 461.
PROFESSORS L. S. RHODES, B. A. WHISLER

C. E. 562. Technical Fluid Mechanics (2-6) Analysis of two and three dimensional flow of fluids; analogical methods; flow through porous media; transportation of silt and detritus. Prerequisite: C. E. 61. Prerequisite or concurrent: Math. 431. PROFESSORS L. S. RHODES, J. M. ROBERTSON

C. E. 563. Advanced Independent Studies in Hydraulics or Hydrology (3-6) Advanced investigation of an approved project in hydraulics or hydrology. Prerequisite: C. E. 462. Lecture 1 hour minimum, practicum 6 hours minimum. PROFESSORS J. M. ROBERTSON, B. A. WHISLER

C. E. 564. Hydraulic Engineering Design (2-6) Design and analysis of selected units of a typical hydraulic engineering project. Prerequisite: C. E. 462.
PROFESSORS J. M. ROBERTSON, A. A. BRIELMAIER

C. E. 565. River Hydraulics and Flood Control (2-5) Advanced theory of open channel flow with application to channels; backwater studies; methods of flood control; design problems of structures in flood control districts. Prerequisites: C. E. 461, 462. Lecture 2 hours minimum.
PROFESSORS J. M. ROBERTSON, B. A. WHISLER

C. E. 571. Water Purification and Softening (2-6) The principal methods of softening and purifying water for potable and commercial purposes. Prerequisite: C. E. 471. PROFESSOR R. E. STIEMKE

C. E. 572. Sewage Disposal (2-6) Methods of disposal of sewage by dilution, tank treatment, oxidation processes, etc. Prerequisite: C. E. 472.
PROFESSOR R. E. STIEMKE

C. E. 573. Sanitary Engineering Projects (3-10) Investigation of problems in water, sewage, and wastes treatment. Prerequisite: C. E. 472.
PROFESSORS R. E. STIEMKE, R. R. KOUNTZ

C. E. 575. Industrial Waste Treatment and Disposal (2-5) Industrial waste disposal problems; sanitary analyses and characteristics of industrial wastes; stream pollution and the factors involved in the self-purification of streams. Prerequisite: C. E. 472. Lecture 2 hours minimum, practicum 3 hours minimum.
PROFESSOR R. E. STIEMKE

C. E. 576. Water Treatment Plant Design (3-6) Design of works connected with the treatment of water for potable, commercial, and industrial purposes. Prerequisite: C. E. 70. Lecture 2 hours minimum, practicum 3 hours minimum.
PROFESSOR R. E. STIEMKE

C. E. 577. Sewage Treatment Plant Design (3-6) Design of work connected with the treatment and disposal of sewage and/or trade wastes. Prerequisite: C. E. 71. Lecture 2 hours minimum, practicum 3 hours minimum.
PROFESSOR R. E. STIEMKE

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

C. E. 401a,b,c,d. Civil Engineering Projects (2-12)

C. E. 412. Photogrammetry (3) Fee $5.

C. E. 421. Transportation Design and Construction (3) Fee $1.

C. E. 422. Transportation Operation and Maintenance (3)

C. E. 441. Statically Indeterminate Structures (Steel) (3)

C. E. 442. Statically Indeterminate Structures (Concrete) (3)

C. E. 443. Photoelasticity and Model Analysis (2) Fee $1.50.

C. E. 444. Soil Mechanics and Foundations (3) Fee $2.50.

C. E. 461. Advanced Hydrology (3)

C. E. 462. Advanced Hydraulics (3) Fee $1.

C. E. 471. Municipal and Rural Sanitation (3)

C. E. 472. Sewage Treatment (3) Fee $2.50.

C. E. 473. Sanitary Engineering Problems (3)

C. E. 481. Municipal Planning and Zoning (3)

C. E. 482. Municipal Engineering and Management (3)

COMMERCE

PROFESSOR CARL W. HASEK, M.A., Ph.D.

Head of the Department of Economics

The following course may be taken for graduate credit under the restrictions in force:

Com. 400. Problems in Business Administration (3)

DAIRY HUSBANDRY

PROFESSOR ANDREW A. BORLAND, M.S.

Head of the Department

D.H. 501. Butter and Cheese (1-6) Investigations in the manufacture and handling of butter and cheese. Prerequisites: D.H. 10, 23, Bact. 8, Agr. Biochem. 403. Fee $1 per credit. PROFESSOR C. D. DAHLE

D.H. 502. Condensed Milk and Milk Powder (1-6) Problems involved in the condensing and drying of milk. Prerequisites: D.H. 10, 26, Bact. 8, Agr. Biochem. 403. Fee $1 per credit. PROFESSOR F. J. DOAN

D.H. 503. Public Milk Problems (1-6) Problems involved in the handling of milk in modern plants. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403. Fee $1 per credit. PROFESSOR F. J. DOAN

D.H. 504. Ice Cream Manufacture (1-6) Investigations in the manufacture of ice cream, ices, and other frozen milk products. Prerequisites: D. H. 11, Bact. 8, Agr. Biochem. 403. Fee $1 per credit. PROFESSOR C. D. DAHLE

D.H. 505. Creamery Economics (1-6) Investigations of the economic factors involved in creamery operation and management. Prerequisites: D.H. 7, 11. PROFESSOR C. D. DAHLE

D.H. 506. Dairy Cattle Breeding (1-6) Special problems involving breed history, pedigrees, selection and judging of dairy cattle. Prerequisites: D.H. 1, 30. Fee $1 per credit. PROFESSOR C. B. KNODT

D.H. 507. Dairy Cattle Management (1-6) Problems in the management of dairy cattle. Prerequisite: D.H. 27. Fee $1 per credit. PROFESSOR A. L. BEAM

D.H. 508. Dairy Seminar (1) Definite problems in dairying; preparation and presentation of a paper on an assigned subject. PROFESSOR A. A. BORLAND AND STAFF

D.H. 510. Dairy Cattle Feeding (1-6) The application of the newer discoveries in animal nutrition to the feeding of dairy cattle. Prerequisites: D.H. 1, 29. Fee $1 per credit. PROFESSORS A. L. BEAM, C. B. KNODT

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

D.H. 418. Dairy Survey (1) Fee $2. PROFESSOR A. A. BORLAND

D.H. 421. Dairy Manufacturing Problems (1-6) Fee $1 per credit. PROFESSORS C. D. DAHLE, F. J. DOAN, AND STAFF

D.H. 427. Milk Secretion (3) Fee $2. PROFESSOR C. B. KNODT

D.H. 428. Dairy Production Problems (1-3) Fee $1 per credit. PROFESSOR A. L. BEAM AND STAFF

D.H. 429. Testing Dairy Products (1-6) Fee $1 per credit. PROFESSOR W. D. SWOPE AND STAFF

D.H. 430. Technical Control of Dairy Products (4) Fee $10. MESSRS. N. A. PERRY, G. H. WATROUS JR.

D.H. 431. Physiology of Reproduction in Farm Animals (3) Fee $5. PROFESSOR J. O. ALMQUIST

DRAMATICS

Consult PROFESSOR ARTHUR C. CLOETINGH, M.A.

Dram. 501. Problems of Production (3-6) Seminar in problems of production with particular stress on direction. Students will direct plays under the staff supervision. Fee $3.50 for three credits; $7 for six credits.
PROFESSOR A. C. CLOETINGH

Dram. 502. Graduate Seminar in the Technical Problems of Dramatic Production (3) Prerequisite: Dram. 11. Fee $3.50. PROFESSOR A. C. CLOETINGH

Dram. 503. Art of Dramatic Lighting (3) Graduate seminar in stage lighting; advanced study in the theory of lighting as used for dramatic effectiveness. Practical work required of each student. Prerequisite: Dram. 12. Fee $3.50. PROFESSOR A. C. CLOETINGH

Dram. 504. Graduate Seminar in Styles of Acting and Directing (3) Practical work required of each student. Fee $3.50. PROFESSOR A. C. CLOETINGH

Dram. 506. Evaluation and Appreciation of Modern Dramatic Entertainment (3) Prerequisite: Dram. 1, 61. Fee $3.50.
PROFESSOR A. C. CLOETINGH

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Dram. 403. Advanced Make-Up (1) Fee $1.50.

Dram. 412. Dramatic Design (3) Fee $3.50.

Dram. 421. Advanced Playwriting (3)

Dram. 431. History of the Theater (3)

Dram. 441. Educational Dramatics (Children's Entertainment) (3) Fee $3.50.

Dram. 442S. Educational Dramatics (3) Fee $3.50.

Dram. 443S. Educational Dramatics (Advanced Marionettes) (3) Fee $3.50.

Dram. 451. Directing (3) Fee $3.50.

Dram. 470. Dramatics in the Schools (3) Fee $3.50.

Dram. 480. Radio Drama (3) Fee $3.50.

Dram. 481. Advanced Radio Drama (3) Fee $3.50.

ECONOMICS

PROFESSOR CARL W. HASEK, M.A., Ph.D.
Head of the Department

Econ. 500. Economics Seminar (3-6) Seminar 3 hours.

Econ. 501. Economics Seminar (3-6) Seminar 3 hours.

Econ. 502. Valuation of Public Utilities (3) PROFESSOR F. H. COOK

Econ. 503. Prices and Profits (3)

Econ 504. Problems of Corporation Finance (3) PROFESSOR G. L. LEFFLER

Econ. 505. Transportation Seminar (3) Prerequisite: Com. 15. Seminar 3 hours. PROFESSOR R. H. WATERS

Econ. 507. International Economic Relations (3) PROFESSOR W. M. HENCH

Econ. 508. Banking Problems (3) PROFESSOR D. H. MCKINLEY

Econ. 509. Taxation Problems (3) PROFESSOR R. S. STOUT

Econ. 510. Demand Analysis (3)

Econ. 511. Economic Bases for Control of Industrial Disputes (3) Prerequisites: Econ. 1 or 14, 15. Lecture 3 hours. PROFESSOR D. S. BROWN

Econ. 512. Wages (3) PROFESSOR D. S. BROWN

Econ. 515. Labor Seminar (3) PROFESSOR D. S. BROWN

Econ. 520. Advanced Economic Statistics (3) Prerequisites: 6 credits in economics and 3 in statistics. PROFESSOR R. B. SAYLOR

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Econ. 400. History of Economic Thought (3) PROFESSOR C. W. HASEK

Econ. 401. Recent Economic Thought (3) PROFESSOR C. W. HASEK

Econ. 410. Economics of Consumption (3) PROFESSOR S. KEYES

Econ. 411. Economics of Labor Relations (3)

Econ. 412. Economics of Collective Bargaining (3)

Econ. 414. Economics of Labor Legislation (3) PROFESSOR D. S. BROWN

Econ. 415. Social Insurance (3) PROFESSOR D. S. BROWN

Econ. 416. Management of Labor Relations (3)

Econ. 417. International Commercial Policies (3) PROFESSOR W. M. HENCH

Econ. 418. Elementary Wage Theory (3)

Econ. 420. Investments (3) PROFESSOR G. F. MITCH

Econ. 421. Central Banking Systems (3) PROFESSOR D. H. MCKINLEY

Econ. 422. Investment Banking (3) PROFESSOR G. L. LEFFLER

Econ. 423. Pennsylvania Local Finance (3) PROFESSOR R. S. STOUT

Econ. 424. Pennsylvania State Finance (3) PROFESSOR R. S. STOUT

Econ. 425. The Money Market (3) PROFESSOR D. H. MCKINLEY

Econ. 430. National Planning (3) PROFESSOR S. KEYES

Econ. 432. Pennsylvania School Finance (3) PROFESSOR R. S. STOUT

Econ. 435. Problems of Federal Finance (3) PROFESSOR R. S. STOUT

Econ. 450. The Business Cycle (3) PROFESSOR C. W. HASEK

EDUCATION

PROFESSOR WILLIS E. PRATT, M.A., Ph.D.
Head of the Department

Ed. 501. Introduction to the Advanced Study of Education (1) Methods of scientific research; criticism of studies in the light of the canons of scientific method; types of research, the nature and standards of these for postgraduate degrees. PROFESSOR W. E. PRATT

Ed. 515. Comparative Education (3) Education in foreign countries, especially England, France, Germany, Italy, and Russia in contrast to American education; special investigations of recent educational progress of such nations as China, Japan, Denmark, Sweden, Switzerland, Poland, Greece, Spain, and Mexico; the cultural quality and political status of some South American countries. Prerequisite: Psy. 14. Lecture 3 hours.
PROFESSOR C. D. CHAMPLIN

Ed. 516. Social Foundations of the Curriculum (2-4) The fundamental nature of education and its relation to social efficiency; scope and character of the school's part in the educational process; organization of the curriculum in a socialized school; the functioning of education in and for democracy; progressive education in theory and practice. Prerequisites: Ed. 25, Psy. 14. Lecture 2 to 4 hours. PROFESSOR C. D. CHAMPLIN

Ed. 517. Evolution of Educational Thought (2-3) Educational thought from early Greeks to the present; as an outcome of social, economic, religious, philosophical, and political theory and practice. Prerequisite: graduate maturity. Lecture 2 or 3 hours. PROFESSOR C. D. CHAMPLIN

Ed 520S. Practicum in the Scientific Determination of Methods of Teaching (3) Prepares advanced graduate students for research; summer term used to acquaint students with the technique of a type of research and to formulate a problem for each student and a detailed plan for its study. These planned researches are to be carried out during the following school year. Prerequisite: 18 credits in education and psychology.

Ed. 522. Production of Educational Moving Pictures (1-3) A laboratory course arranged co-operatively with the College Motion Picture and Recording Studio. The student participates in the production of educational films. Prerequisites: Ed. 424, 488, 487 (Unit B). Conference 1 hour, alternate weeks by appointment. Practicum 1 to 5 hours.
PROFESSOR A. W. VANDERMEER

Ed. 523. Laboratory in Organizational Aspects of Materials of Instruction (1-3) Experience in organizing, storing, and maintaining verbal and nonverbal instructional materials in a manner that will facilitate their curricular use. Facilities of the Instructional Materials Center and the Audio-Visual Library will be used. Prerequisites: Ed. 424, 585. Conference 1 hour, alternate weeks by appointment. Practicum 1 to 5 hours.
PROFESSOR A. W. VANDERMEER

Ed. 524. Seminar in Curriculum Materials and Their Utilization (3) Techniques of communication of ideas through various teaching devices commonly used in public schools; relation of specific materials and techniques of presentation to types of learning; organization of curriculum materials in relation to the learning process and individual differences in students. Prerequisites: Ed. 424, 585, 6 hours of educational psychology. Lecture 3 hours. PROFESSOR A. W. VANDERMEER

Ed. 525. Modern Tendencies in Educational Method (2-3) Aims to develop an understanding of the science supporting dynamic instruction; basic principles of teaching developed inductively; careful analysis of modern procedures such as the unit and unit assignment, individual instruction, project method, problem method, laboratory study plan, ability grouping, and the activity concept. Prerequisite: 12 semester hours of undergraduate work in education. PROFESSOR F. A. BUTLER

Ed. 527. Problems in the Education of the Mentally Retarded (1-4) Intensive study of existing educational procedures; analysis of life needs of the mentally retarded; experimentation in construction of curriculum, instructional materials, long-term planning, and follow-up programs. Prerequisites: Ed. 426 and teaching experience, Ed. 427 or 583, Unit P. Lecture 1 to 4 hours.

Ed. 532. Supervision of Student Teachers (3) Practical problems of organizing, administering, and teaching courses in observation and practice teach-

ing. Prerequisite: experience in teaching, and 18 credits in education, including at least 5 credits in methods. Lecture 3 hours.

PROFESSOR F. E. TAYLOR

Ed. 533. Psychology of Reading (2-3) Problems in the analysis of meaning; the context theory of meaning, word-fact relationships, shifts in meaning, interpretation of metaphor, and levels of abstraction; emphasis on the semantic approach to reading problems in elementary and secondary schools. Prerequisite: Ed. 432b or 432c. Lecture 2 or 3 hours.

Ed. 534a. Reading Clinic Practice: Analysis of Reading Disabilities (1-9) A laboratory course in the reading analysis division consisting of analysis of extreme reading disabilities, case typing, prognosis, and recommended remedial procedures; experience in techniques, procedures, and the preparation of case reports; attendance at scheduled staff meetings required; individual reading clinic practice under supervision arranged by appointment. Prerequisite: Ed. 432g or Psy. 476. Fee $1.50.

Ed. 534b. Reading Clinic Practice: Remedial Procedures (1-9) Practicum in special classes for reading disabilities; corrective and remedial procedures demonstrated; experience in dealing with specific procedures for the correction of various types of reading disabilities. Attendance at scheduled staff meetings required. Individual reading clinic practice under supervision arranged by appointment. Prerequisite: Ed. 432g or 534a. Fee $1.50.

Ed. 535. Seminar on Reading Instruction (2-12) Designed to appraise significant researches, to acquaint the student with research procedures, to outline procedures and materials for research. Reading readiness, word perception, basic reading skills, vocabulary development, sociology of reading, readability, reading interests, eye movements, hygiene of reading, differentiated instruction, factors in reading ability, study, language development, and dyslexia. Prerequisites: Ed. 432b or 432c.

Ed. 536. Reading Clinic Research (1-15) Prerequisites: Ed. 432b; or 432c, 432g.

Ed. 540. Problems of Elementary Education (2-3) Desirable outcomes of elementary education; characteristics of children; individual differences and homogeneous grouping; influence of scientific studies of education upon materials and methods. Prerequisite: 12 credits in education and psychology, including 6 credits in elementary education. PROFESSOR PAUL BIXBY

Ed. 546. Elementary School Principal as Supervisor (2-3)

PROFESSOR PAUL BIXBY

Ed. 548. Organization of the Elementary School Curriculum (2-3) Principles underlying curriculum construction; the organization by the student of a curriculum for an elementary school, showing the adaptation of the best educational theory and practice to meet the needs of a specific community. Prerequisite: Ed. 31 or teaching experience. Lecture 2 or 3 hours.

Ed. 550. Problems in Modern Secondary Education (1-4) The historical, psychological, social, and economic factors influencing secondary education; emphasis upon the emerging philosophy, curricula, objectives, issues, functions, and procedures. Required as basic course of all graduate students in secondary education. Prerequisite: Ed. 450 or secondary school teaching.

PROFESSOR F. A. BUTLER

Ed. 551. Seminar in Contemporary Issues in Secondary Education (2-9)

UNIT A. THE SECONDARY SCHOOL CURRICULUM (2-3) Principles and philosophy of curriculum construction. Each student will work out an individual

problem in the secondary school curriculum. Prerequisites: 12 credits in education and psychology, and teaching experience. PROFESSOR J. H. MOYER

UNIT B. LABORATORY STUDIES IN APPLICATION OF EDUCATIONAL METHOD (2-3) Analysis and application of outstanding studies in secondary education. Open to experienced high school teachers interested in integrating the results of educational research with public school procedures. Prerequisites: 12 credits in education and psychology, and teaching experience.

UNIT C. ORGANIZATION AND ADMINISTRATION OF SECONDARY EDUCATION (2-3) Problems related to the reorganization of secondary education, with particular reference to the junior high school; designed for teachers and principals who want to study the philosophy, organization, and teaching problems of the junior high school. Prerequisites: 12 credits in education and psychology, and teaching experience.

Ed. 556. The Secondary School Principal as Supervisor (2-3) Improvement of instruction on the secondary school level; selection of teachers; improvement of teachers in service; evaluation of teaching procedures; methods of supervision; selection and use of textbooks; evaluation of supervisory programs and other topics. Prerequisite: three years' teaching experience. Lecture 2 hours. PROFESSOR M. J. WYLAND

Ed. 558S. Administrative Work of the Dean of Girls (3) A critical and constructive study of the work of the dean of girls in supervising extracurricular activities, social activities, sororities, and residence halls; the relation to personnel work and the use of personnel records. Prerequisite: Ed. 458.

Ed. 561. The Junior College (2-3) The relation of junior colleges to public education programs; history, philosophy, functions, organization, administration, maintenance, location, student and teaching personnel; curricular and extracurricular activities; standards. Prerequisite: any one of the following—Ed. 450, 480, 550, 556, 567, or educational administrative experience. PROFESSOR P. C. WEAVER

Ed. 562. Curricula and Instructional Procedures in Junior Colleges (2-3) Course offerings and organization of curricula for postsecondary and junior college students; instructional materials and procedures; the place and function of guidance; extracurricular activities; student personnel problems; and the evaluation of results. Prerequisite: Ed. 450, 480, 556, 567, or educational administrative experience. Lecture 2 or 3 hours. PROFESSOR P. C. WEAVER

Ed. 563. The Professional Education of Teachers (3) The development and present status of teacher education; objectives and standards; selection and guidance of students; personnel problems in relation to staff; principles and trends in organization of program of study and curricula; administration and organization; financial management; evaluation of achievement; research; stimulation of professional improvement of in-service teachers. Prerequisites: 6 credits in advanced courses in education and a course in educational psychology. Lecture 3 hours. PROFESSOR W. E. PRATT

Ed. 567. Problems in Collegiate Education (2-3) Designed to give a better understanding of relationships between higher education and the educational program as a whole. Historical developments of higher education; the place of the state and local governments; the functions of various types of higher institutions; their government; internal organization and administration; financial support; foundations; and accrediting agencies. Prerequisite: Psy. 14. Lecture 2 hours. PROFESSOR P. C. WEAVER

Ed. 568. Problems in Collegiate Education (2-3) Aims and objectives of higher institutions; principles and current trends in curriculum construction; general education; selection of students; guidance and personnel; student activities, and measurement of results. Prerequisite: Psy. 14.
PROFESSOR P. C. WEAVER

Ed. 569. Seminar in Collegiate Education (1-6) Special topics in higher education. Prerequisite: Ed. 567. Lecture 1 to 6 hours. PROFESSOR P. C. WEAVER

Ed. 570, 570X. Diagnostic Testing and Remedial Teaching (2-3) The technique of diagnostic testing and remedial teaching and critical evaluation of tests available. Planned primarily for candidates for the Doctor of Education degree. Prerequisite: 18 credits in education and psychology, including educational measurements. Lecture 2 or 3 hours.

Ed. 574. Advanced Educational Statistics (2-4) Derivation of the formulae used in elementary statistics, practice in evaluating the uses, statistical procedures, and interpretations of the result; partial and multiple correlation, special formulae for correlation; transmutation of scores; weighting elements of a battery of tests; curve fitting, particularly as related to the normality of a distribution and to the growth curve. Prerequisite: at least a 2-credit course in elementary statistics. Lecture 2 to 4 hours.

Ed. 575. Administration and Supervision in Business Education (3) The work of administrators, directors, supervisors, department heads, and others responsible for improvement of instruction and development of sound business education programs; importance of close co-operation between school and business; use of vocational testing, job analysis, surveys, and research in improving programs of business education. Prerequisite: 6 credits in secondary education. Lecture 3 hours. PROFESSOR J. J. GEMMELL

Ed. 576. Introduction to Research in Business Education (3) Designed to acquaint students with methods of research in business education. Opportunity to compile useful annotated bibliographies on current problems in business education; practice in analysis and evaluation of significant researches and current periodical articles on business education. Lecture 3 hours. PROFESSOR J. J. GEMMELL

Ed. 577. Evolution of Research and Empirical Literature in Business Education (3) Application of evaluation methods to current literature in business education; special attention to research studies. Prerequisite: Ed. 576. Lecture 3 hours. PROFESSOR J. J. GEMMELL

Ed. 578. Seminar in Business Education (3) Intended for graduate students preparing theses or final documents, or for those working on special studies in business education. Prerequisite: Ed. 577. Lecture 3 hours.
PROFESSOR J. J. GEMMELL

Ed. 580. Seminar in School Administration (2-3) Deals with efficiency in supervision, methods of diagnosis and evaluation of teaching and learning procedure, improving instruction, maintaining teacher morale, and stimulating co-operative work. For superintendents, principals, department heads, advisers, and others with administrative or supervisory duties. Prerequisites: Ed. 25, 31, 480, or teaching experience. Lecture 2 or 3 hours.
PROFESSOR W. E. PRATT

Ed. 582. Educational Survey Techniques (2-3) The progress and results in local school systems; undertakes to study how to make school surveys. A ma-

jor project for Doctor of Education candidates. Students will be expected to make a survey in the local school system during the following year.
PROFESSOR W. S. VINCENT

Ed. 583. Problems in Administration and Supervision (1-24)

UNIT A. THE EDUCATIONAL PLANT (2) PROFESSOR W. S. VINCENT

UNIT B. PUBLIC RELATIONS FOR SCHOOL ADMINISTRATORS (2-3)
PROFESSOR W. S. VINCENT

UNIT C. PUBLIC SCHOOL FINANCE (2) PROFESSOR W. S. VINCENT

UNIT D. ADMINISTRATION OF THE TEACHING PERSONNEL (1)
PROFESSOR W. E. PRATT

UNIT E. THE PROGRAM OF INSTRUCTION (2) PROFESSOR W. E. PRATT

UNIT F. STATE AND NATIONAL EDUCATION PROGRAM (1)
PROFESSOR W. S. VINCENT

UNIT G. LOCAL SCHOOL ORGANIZATION AND ADMINISTRATION (2)
PROFESSOR W. S. VINCENT

UNIT H. THE SCHOOL SURVEY (2) PROFESSOR W. S. VINCENT

UNIT I. ADMINISTRATION OF ADULT EDUCATION IN THE PUBLIC SCHOOLS (2)
PROFESSOR W. S. VINCENT

UNIT J. SCHOOL REVENUE (2) PROFESSOR W. S. VINCENT

UNIT M. LEGAL ASPECTS OF SCHOOL ADMINISTRATION (2)
PROFESSOR W. S. VINCENT

UNIT N. THE SCHOOL POPULATION (2) PROFESSOR W. S. VINCENT

UNIT O. AUXILIARY AND CO-ORDINATE AGENCIES (1) PROFESSOR W. S. VINCENT

UNIT P. THE ADMINISTRATION OF PUBLIC SCHOOL EDUCATION FOR ATYPICAL CHILDREN (2) PROFESSOR M. A. NEUBER

UNIT Q. DYNAMIC FACTORS IN SCHOOL ADMINISTRATION (2) Fee $1.50.
PROFESSOR W. S. VINCENT

UNIT R. PUBLIC SCHOOL BUSINESS ADMINISTRATION (2-3) Fee $1.50.
PROFESSOR W. S. VINCENT

Ed. 585. Curriculum Construction (2-3) Governing principles in curriculum construction and the educational value of each; analysis of subject matter and organization of such material into units of instruction; the most effective type of curriculum and the function of the administrator, supervisor, and teacher in its construction. PROESSOR W. E. PRATT

Ed. 585aS. Sociological Foundations of Curriculum Construction (3-6) Principles and methods of curriculum construction; researches on social needs and educational values; planning a series of researches in curriculum construction. Students may earn additional credit during the following winter by carrying out their researches.

Ed. 586. Principles of School Supervision (2-3) Principles and techniques of supervision; organization of supervision; planning the supervisory program; developing standards of teaching and learning; improvement of learning through tests, teacher rating, and other devices. For superintendents, supervising principals, elementary and high school principals, supervisors, and others preparing for such positions. Prerequisites: 18 credits in education and 3 years' teaching experience. Lecture 2 or 3 hours.
PROFESSOR W. E. PRATT

Ed. 587. The Secondary School Principal as Administrator (2-4) The work of the administrator of a junior or senior high school; problems of schedule making, teachers' meetings, curriculum making and revision, and organization of extracurricular and guidance programs. Prerequisite: teaching experience. PROFESSOR M. J. WYLAND

Ed. 589. The Elementary School Principal as Administrator (2-3) Pupil and teacher personnel management; course of study; programs and schedules; articulation; health; extracurricular programs; textbook supply and equipment management; care and use of buildings and grounds; reports; community relations. Prerequisite: Ed. 442. Lecture 2 or 3 hours.
PROFESSOR PAUL BIXBY

Ed 590. Philosophy of Education (2-4) Fundamental principles of education; scientific sanctions of progressive instructional practices and professional experiences as bases for the formulation of the educational creed. Prerequisite: 18 credits in education. Lecture 2 to 4 hours.
PROFESSOR C. D. CHAMPLIN

Ed. 594. Seminar in Education (1-6) Conferences and discussions designed to meet the need for special study of particular fields in education. Prerequisite: requirements for graduation in education. PROFESSOR W. E. PRATT

Ed. 595. Educational Research (1-15) An inductive research from primary sources expected to maintain standards sufficiently high to warrant publication of the findings. Prerequisite: at least 6 hours of graduate study in education, including some work in statistics.

Ed. 597S. Workshop in Current Educational Problems (1-6) Seminar for administrators, supervisors, experienced elementary and secondary teachers, and guidance workers; administrative, supervisory, and instructional problems involved in an emerging educational program. Units determined by current educational needs. Prerequisite: 12 credits in graduate work in education. Lecture 1 to 6 hours. PROFESSOR M. J. WYLAND AND STAFF

Ed. 599. Thesis (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Ed. 412, 412X. History of Modern European Education (3)
PROFESSOR C. D. CHAMPLIN

Ed. 420S. Preschool, Kindergarten, and Primary Education (3)

Ed. 421X. Modern Tendencies in Educational Method (2-3)

Ed. 422S. The Progressive School (2-3)

Ed. 424, 424X. Visual and Other Sensory Aids in Education (1-3) Fee $2.
PROFESSOR A. W. VANDERMEER

Ed. 425, 425X. The Scientific Direction of Learning Activities (2-4)
MR. S. D. MELVILLE

Ed. 426, 426X. Education of Exceptional Children (2-3) Fee $1.
PROFESSOR M. A. NEUBER

Ed. 427. Education of the Mentally Retarded (2-3) Fee $1.
PROFESSOR M. A. NEUBER

Ed. 428, 428X. Units A, B, C. Adult Education: Organization, Types, and Methods (1-3) PROFESSOR C. D. CHAMPLIN

Ed. 429, 429X. The Gifted Child (1-3) PROFESSOR M. A. NEUBER

Ed. 432b, 432bX. The Elementary School Reading Program (2-3)

Ed. 432c, 432cX. Reading Problems in the Secondary School (2-3)

Ed. 432d, 432dX. Special Problems in the Teaching of Elementary School English (2-3)

Ed. 432eX. Choral Speaking (3)

Ed. 432f, 432fX. Teaching Secondary School English (2-3)

Ed. 432g, 432gX. Reading Disabilities (2-3) MR. S. D. MELVILLE

Ed. 432h, 432hX. Techniques in Remedial Reading (2-6) Fee $1.50.
MR. S. D. MELVILLE

Ed. 432iX. Field Problems in Reading (3)

Ed. 432k. Preparation of Instructional Materials (2-6)

Ed. 433f, 433fX. Teaching Children's Literature (2-3)

Ed. 433gS. Primary Arithmetic (3)

Ed. 433h, 433hX. Problems of Elementary School Arithmetic (2-3)
PROFESSOR M. A. NEUBER

Ed. 433n, 433nX. Teaching Social Studies in the Elementary Grades (2-3)
PROFESSOR F. E. TAYLOR

Ed. 433w, 433wX. Teaching Social Studies in the High School (2-3)
PROFESSOR A. W. VANDERMEER

Ed. 433y, 433yX. Teaching Mathematics in the Secondary School (3)

Ed. 435, 435X. Education for Citizenship (2-3) PROFESSOR C. D. CHAMPLIN

Ed. 435cS. Teaching the Problems of Democracy (2-3)

Ed. 435dS. Methods in History (3)

Ed. 437S. Methods in Teaching Home Hygiene Courses (3) Fee $1.50.

Ed. 438, 438X. Teaching Science in Secondary Schools (2-3) Fee $2.50.
PROFESSOR G. J. FREE

Ed. 438e, 438eX. Teaching Science in the Elementary School (1-3) Fee $2.
PROFESSOR G. J. FREE

Ed. 439. Teaching Traffic Safety and Automobile Operation (1-3) Fee $5.
PROFESSOR A. E. NEYHART, MR. JOSEPH INTORRE

Ed. 441, 441X. Psychology of Elementary School Subjects (2-3)
PROFESSOR PAUL BIXBY

Ed. 442, 442X. Elementary Education (2-3) PROFESSOR PAUL BIXBY

Ed. 448X. Organization of the Elementary School Curriculum (2-3)
PROFESSOR PAUL BIXBY

Ed. 449aS. Teaching of Conservation of Natural Resources in the Elementary School (3) PROFESSOR G. J. FREE

Ed. 449bS. Teaching of Conservation of Natural Resources in the Secondary School (3) PROFESSOR G. J. FREE

Ed. 450, 450X. Secondary Education (2-3) PROFESSOR F. A. BUTLER

Ed. 453, 453X. Educational and Vocational Guidance (2-3)
PROFESSOR M. J. WYLAND

Ed. 454, 454X. Extracurricular Activities in the Junior and Senior High School (2-3) PROFESSOR J. H. MOYER

Ed. 455. Psychological Principles of Secondary School Subjects (2-3)
PROFESSOR F. A. BUTLER

Ed. 456, 456X. Principles and Problems of Commercial Education (1-3) PROFESSOR J. J. GEMMELL

Ed 457S. Teaching Problems of the Junior High School (2-3)

Ed. 458S. The Dean of Girls in the High School (3)

Ed. 459, 459X. Improvement of Instruction in Commercial Skill Subjects (1-3) PROFESSOR J. J. GEMMELL

Ed. 460. Curricula in Business Education (3) PROFESSOR J. J. GEMMELL

Ed. 461. Improvement of Instruction in Basic Business Subjects (3) PROFESSOR J. J. GEMMELL

Ed. 462. Teaching Shorthand and Typewriting (3) PROFESSOR J. J. GEMMELL

Ed. 463. Teaching of Bookkeeping (2-3) PROFESSOR J. J. GEMMELL

Ed. 466. Teaching of Office Practice (3)

***Ed. 470, 470X. Educational Measurements (2-3)** Fee $2.

Ed. 474, 474X. Teaching of Occupations (2-3)

Ed. 480, 480X. Educational Administration (2-3) Fee $1.50. PROFESSOR W. S. VINCENT

Ed. 482X. Supervision and Improvement of Instruction (2-3) PROFESSOR W. E. PRATT

Ed. 483S. Principles and Procedures in Family and School Relationships (3)

Ed. 485X. Curriculum Construction (2-3) PROFESSOR W. E. PRATT

Ed. 487, 487X. Problems in Visual and Other Sensory Aids in Education, Unit A (1-3), Unit B (1-2), Unit C (1-2), Unit D (1-2) Fee $1 for Unit B, $1 for Unit C. PROFESSOR A. W. VANDERMEER

Ed. 489. Professional Orientation of the Teacher (1-9) PROFESSORS F. A. BUTLER, J. H. MOYER, M. J. WYLAND

Ed. 490X. Philosophy of Education (3) PROFESSOR C. D. CHAMPLIN

Ed. 493, 493X. Character Education and Guidance (2-3) PROFESSOR C. D. CHAMPLIN

Ed. 494. Religious Education (2-3)

Ed. 496S. Teaching Problems in Relation to Industry (2-3)

Ed. 497S. Workshop in Selected Studies in the Field of Elementary and Secondary Education (1-6) PROFESSOR M. J. WYLAND AND STAFF

Ed. 499. Problems of Special Education (3) PROFESSOR M. A. NEUBER

ELECTRICAL ENGINEERING

PROFESSOR ERIC A. WALKER, M.S., Sc.D.
Head of the Department

E.E. 520. Seminar (1) Required of all graduate students in electrical engineering. Conferences, reading, and presentation of technical papers.

E.E. 521a,b,c,d. Alternating-Current Theory (2-12) Special problems in alternating-current theory and the application of these problems to alternating-current circuits or machinery at any frequencies. Lecture and investigations 2 to 12 hours.

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*No credit if credit has been received for Ed. 70.

E.E. 522. Power Generation (3) Problems of the generating station in the electrical power system including economic and technical considerations of station location, operation, and control; selection and layout of equipment. Lecture 3 hours. PROFESSORS E. W. JONES, A. P. POWELL

E.E. 523. Transients in Linear Systems (3) Transient response of linear electric circuits and electromechanical systems including the application of operational methods of analysis to electrical and electromechanical problems. Prerequisite: E. E. 423. Lecture 3 hours. PROFESSOR C. B. HOLT

E.E. 524. Engineering Electronics (3) Special problems dealing with the design and application of electronic devices and systems; emphasis upon individual projects closely related to other phases of the student's graduate program. Lecture 2 hours, practicum 3 hours. PROFESSOR E. B. STAVELY

E.E. 525. Symmetrical Components (3) Polyphase circuits and machines under unbalanced conditions of operation including the effects of rotating machines upon the distribution and transmission system performance; characteristics of phase converters, and single-phase operation of polyphase systems. Prerequisite: E. E. 425. Lecture 3 hours. PROFESSOR C. B. HOLT

E.E. 526a,b. Electric Illumination (3-6) Problems in photometry; methods of evaluating illumination in terms of safety and seeing value; development of improved methods for illumination calculations. PROFESSOR D. L. MARKLE

E.E. 527. Electrical Design Engineering (3) Special problems in the design of alternating and direct-current apparatus. Lecture and design 3 hours. PROFESSORS E. B. STAVELY, L. A. DOGGETT

E.E. 528. Servomechanisms (3) An advanced treatment of the transient and steady-state behavior of closed-cycle control systems with special attention to stability and the design of stabilizing controllers. Prerequisite: E. E. 428. PROFESSORS H. I. TARPLEY, C. B. HOLT

E.E. 529a,b. Precision Measurements (3-6) Advanced measurements in electricity and magnetism, usually involving the development of laboratory techniques applicable to specific research problems; development of special measuring devices. PROFESSORS D. L. MARKLE, E. AXMAN

E.E. 530. Audio Frequency Engineering (3) Electrical systems and equipment used in production, recording, amplification, transmission, and measurement of sound. Prerequisite: E. E. 11 or 13. PROFESSORS F. T. HALL JR., G. L. CROSSLEY

E.E. 531a,b,c. Radio Frequency Engineering (3-9) Radio frequency equipment, measurements, and systems; amplifiers, modulators, demodulators, transmitters, receivers, transmission lines, antennae, and radiators. Prerequisite: E. E. 431. PROFESSORS F. T. HALL JR., G. L. CROSSLEY

E.E. 532. Ultra-High Frequency Engineering (4) Theory of transmission lines, wave guides, resonant cavities, antennae, and wave propagation. Prerequisite: E. E. 432. Lecture 3 hours, practicum 3 hours. PROFESSOR F. T. HALL JR.

E.E. 533. Automatic Control Systems (2-3) Automatic control as applied to railway and industrial motors; telemetering and automatic control of electrical, mechanical, thermal, and chemical quantities. Investigation of existing methods and design of equivalent systems. Much of the course may be adapted to the needs of special interests. Prerequisite: E. E. 4. PROFESSOR P. X. RICE

E.E. 535. Engineering Analysis (3) A continuation of E.E. 435 in which problems are solved by the use of vector analysis, operational calculus, and other special manipulative devices. The problems are limited to those types most frequently appearing in electrical engineering. Prerequisite: E. E. 435. Lecture 3 hours. PROFESSOR E. A. WALKER

E.E. 538. Electro-Magnetic Engineering (3) Electrical and magnetic fields, using the Maxwell-Lorentz equations as applied to vector fields and special solutions for antennae, wave guides, and other engineering applications. Prerequisite: E. E. 438. Lecture 3 hours. PROFESSOR E. A. WALKER

E.E. 550. Communication Networks (3) Methods of filter design using lattice networks; the effects of dissipation on the characteristics of filter networks; transient response of networks and the design of equalizers. Prerequisite: E. E. 450. Lecture 3 hours. PROFESSORS H. I. TARPLEY, F. T. HALL JR.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

E.E. 421a,b,c,d. Electrical Engineering Problems (2-12)
E.E. 423. Transient Phenomena (3) Fee $5. PROFESSOR C. B. HOLT
E.E. 424. Engineering Electronics (3) Fee $5. PROFESSOR E. B. STAVELY
E.E. 425. Symmetrical Components (3) PROFESSOR C. B. HOLT
E.E. 428. Servomechanisms (3) Fee $5. PROFESSOR C. B. HOLT
E.E. 431. High-Frequency Engineering (3) PROFESSOR F. T. HALL JR.
E.E. 432. Ultra-High Frequency Techniques (4) Fee $5. PROFESSOR F. T. HALL JR.
E.E. 434. Industrial Electronics (3) Fee $5. PROFESSOR E. B. STAVELY
E.E. 435. Engineering Analysis (3) PROFESSOR F. T. HALL JR.
E.E. 438. Electricity and Magnetism (3) PROFESSOR A. H. FORBES
E.E. 450. Electrical Network Theory (3) PROFESSOR F. T. HALL JR.
E.E. 460. High Voltage Engineering (3)

ELECTROCHEMICAL ENGINEERING

PROFESSOR ERIC A. WALKER, M.S., SC.D.

Head of the Department of Electrical Engineering

Ech. E. 501. Theory of Electrochemistry (2-4) Laboratory study of advanced electrochemical theory; overvoltage and discharge potentials; application of electrochemistry to recent chemical problems. Investigation. PROFESSOR A. F. WOELFEL

ENGINEERING

DEAN H. P. HAMMOND, *in Charge*

The following course may be taken for graduate credit under the restrictions in force:

Eng. 400. Production Engineering (2-3)

ENGINEERING EXPERIMENT STATION

Professor F. George Hechler, M.E.
Director

Eng. Exp. Sta. 501. Fuel Injection and Combustion in Diesel Engines (2-6) Characteristics and efficiency of various injection systems. Lecture 3 hours. Professor P. H. Schweitzer

Eng. Exp. Sta. 502. Diesel Engine Research (3-15 per semester) An original investigation dealing with the design, construction, operation, or application of Diesel engines. Fee $3 per credit. Professor P. H. Schweitzer

Eng. Exp. Sta. 504. Fuel Spray Laboratory (2) A laboratory study of fuel injection for the Diesel engine. Fee $4. Professor P. H. Schweitzer

Eng. Exp. Sta. 505. Transient Elastic Phenomena (2-3) The analysis, mainly by graphical methods, of transient phenomena in the flow of fluids in pipes with particular attention to the phenomena of injection in Diesel engines; water-hammer in hydraulic conduits; oscillations in the intake and exhaust pipes of engines and compressors; surges in mechanical springs; surges in electric circuits. Lecture 2 or 3 hours. Professor K. J. DeJuhasz

Eng. Exp. Sta. 506. Research in Transient Elastic Phenomena (3-15 per semester) Laboratory research in the fields described under Eng. Exp. Sta. 505. Professor K. J. DeJuhasz

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Eng. Exp. Sta. 401. Theory of Engineering Instruments (2-3) Professor K. J. DeJuhasz

ENGINEERING MECHANICS

Professor John A. Sauer, M.S., Ph.D.
Head of the Department

Mchs. 500. Advanced Mechanics of Materials (3) Strain energy methods; special problems in bending of beams including curved bars, beams on elastic foundations; thick-walled cylinders, shrink-fit assemblies, and rotating discs; bending of thin plates; thin-walled pressure vessels; buckling of bars and plates. Professor J. Marin

Mchs. 504. Applied Elasticity (3) A condensation of Mchs. 507 and 508; emphasis on applications to machine and structural design. Prerequisite: Mchs. 2 or 13. Professor J. Marin

Mchs. 506. Experimental Stress Analysis (3) Experimental methods of stress determination including photoelasticity, stress coat and electric strain gauge techniques; electrical, hydrodynamic, and membrane stress analogies; strain rosettes for combined stress determinations; special experimental methods for structural analysis. Prerequisite: Mchs. 2 or 13. Lecture 2 hours, practicum 3 hours. Professor J. Marin

Mchs. 507. Theory of Elasticity and Applications (3-6) Theory of elasticity; general equations of stress and strain; differential equations of equilibrium,

and applications to beams, curved members, rotating discs, thick cylinders, tanks, rollers, rotating cylinders, plates, and other structural and machine parts. Prerequisite: Mchs. 2 or 13. Lecture 3 to 6 hours.

PROFESSOR J. A. SAUER

Mchs. 508. Theory of Elastic Stability and Applications (3) Bending of columns; buckling of slender and short members; influence of eccentricity and initial curvature in columns; buckling of I-beams; stability of thin-walled constructions; thin-walled cylinders subjected to external pressures; applications to structural parts including aircraft members. Prerequisite: Mchs. 2 or 13. PROFESSOR J. A. SAUER

Mchs. 509. Theory of Plates and Shells (3) Deflection of thin plates; bending of circular and rectangular plates; buckling of plates; plates on elastic foundations; deformation of shells without bending; general theory of cylindrical shells; applications to engineering problems. Prerequisite: Mchs. 2 or 13. PROFESSOR J. MARIN

Mchs. 512. History of Mechanics of Materials (2) Prerequisite: Mchs. 13.

PROFESSORS J. MARIN, P. B. KAPP

Mchs. 513. Thesis (1-9)

Mchs. 514. Engineering Mechanics Seminar (1 per semester) Current literature and special problems in engineering mechanics. Prerequisites: Mchs. 13, 14.

Mchs. 515. Research in Engineering Mechanics (1-15 per semester) Investigation of a theoretical or experimental project in engineering mechanics. Fee $2 per credit.

Mchs. 520. Advanced Dynamics (3) Dynamics of a particle and of rigid bodies; Newtonian equations in moving co-ordinate systems; derivation and application of LaGrange's and Hamilton's equations of motion; normal coordinates; principle of least action; special problems in vibrations and dynamics. Prerequisite: Mchs. 12. PROFESSOR J. A. SAUER

Mchs. 522. Theory of Vibrations (3) Mathematical theory of simple vibrating systems; damping phenomena; forced vibrations; analogy between mechanical and electrical vibrations; multiple degree of freedom systems; transverse and torsional oscillation of shafts; vibration of strings, beams, membranes, and plates. Prerequisites: Mchs. 2 or 13, Math. 84 or 431.

PROFESSOR J. A. SAUER

Mchs. 523. Vibration Problems in Engineering (3) Application of vibration theory to problems of suspension; vibration isolation in machines, ships, and automobiles; torsional oscillation of crankshafts; vibrations of bridges, turbine blades, propeller blades; self-induced vibrations; nonlinear vibrational systems and applications. Prerequisite: Mchs. 522.

PROFESSOR J. A. SAUER

Mchs. 530. Mechanical Properties of Materials and Design (3) True stress-strain relations in tension; plastic stress-strain equations for combined stresses; theories of failure for combined static and fatigue stresses; impact loads; creep of metals subjected to simple and combined stresses. Application to design of structural and machine elements. Prerequisite: Mchs. 2 or 13.

PROFESSOR J. MARIN

Mchs. 531. Theory of Plasticity and Applications (3) Theory of plasticity including plastic torsion and bending of bars; plastic flow in thick-walled cylinders and rotating discs; buckling of bars loaded beyond the yield point

and residual stresses; mechanics of creep for members subjected to combined stresses. Applications to specific problems in structural and machine design. Prerequisite: Mchs. 530. PROFESSOR J. MARIN

Mchs. 533. Advanced Materials Testing (3) Special experiments in materials testing including fatigue, creep, impact, and combined stress studies; determination of true stress-strain diagrams of metals. Lecture 1 hour, practicum 6 hours. PROFESSORS R. K. VIERCK, P. B. KAPP

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Mchs. 400. Advanced Strength of Materials (3) PROFESSOR J. MARIN

Mchs. 401. Elements of Vibrations (3)
PROFESSORS R. K. VIERCK, J. M. ROBERTSON

Mchs. 402. Applied and Experimental Stress Analysis (3)
PROFESSOR J. MARIN

Mchs. 403. Mechanical Properties of Materials and Design (3)
PROFESSOR J. MARIN

Mchs. 404. Research in Engineering Mechanics (1-6)

Mchs. 405. Theoretical Stress Analysis (3)
PROFESSORS J. W. BRENEMAN, R. K. VIERCK

ENGLISH COMPOSITION

PROFESSOR THEODORE J. GATES, M.A.
Head of the Department

Engl. Comp. 502. Ancient Rhetoric and Poetic (3) Rhetorical and poetic doctrine as set forth by the ancients from Aristotle to Horace. Recitation 3 hours.

Engl. Comp. 503. Medieval Rhetoric (3) Rhetorical and poetic doctrine and practice during the Middle Ages. Recitation 3 hours.

Engl. Comp. 504. Renaissance Rhetoric (3) The rhetorical and poetic doctrine and practice during the Renaissance. Recitation 3 hours.

Engl. Comp. 505. Modern English Rhetoric (3) A survey of British and American rhetorical doctrine from 1600 to the present. Recitation 3 hours.
PROFESSOR J. J. RUBIN

Engl. Comp. 510. Prose Style (3) The development of English prose style from the Elizabethan age to Dryden. Recitation 3 hours.
PROFESSOR J. C. MAJOR

Engl. Comp. 511. Modern Prose Style (3) English prose style from 1700 to the present. A continuation of Engl. Comp. 510. Recitation 3 hours.
PROFESSOR J. C. MAJOR

Engl. Comp. 520. Semantics (3) Special studies in semasiology. Recitation 3 hours. PROFESSOR L. F. PECK

Engl. Comp. 528. Advanced English Grammar (3) A comprehensive study of the grammatical structure of the English language; methods of recording syntactic analysis; problems of terminology; a critical evaluation of the systems advanced by recent grammarians. Prerequisite: 6 credits in the field of English language. Recitation 3 hours.

Engl. Comp. 529. Historical English Grammar (3) The evolution of the grammatical system of English; inflectional change and decay; the development of form words and word order as grammatical means; the influence of eighteenth century grammarians; present-day trends. Prerequisite: graduate standing with a major or a minor in English or a foreign language. Recitation 3 hours.

Engl. Comp. 530. Rhetorical Techniques (3) Studies in the techniques of special types of writing, such as humor, satire, and propaganda. Prerequisites: 12 credits in English or American literature and 12 credits in English composition. Recitation 3 hours. PROFESSOR H. F. GRAVES

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Engl. Comp. 404. Public Opinion and Written Persuasion (3)
PROFESSOR H. F. GRAVES

Engl. Comp. 410a,b,cS. Survey of English Composition (1-3)

Engl. Comp. 411a,b,cS. Spoken and Written English (1-3)

Engl. Comp. 418. The Writing of Literary Criticism (3)
PROFESSOR J. J. RUBIN

ENGLISH LITERATURE

PROFESSOR BRICE HARRIS, M.A., Ph.D.
Head of the Department

Engl. Lit. 501. Materials and Methods of Research for English Literature (3) The bibliography of literary history and criticism; methods of editing and annotating texts; the form and materials of dissertations. Required of all graduate students with an English literature major.
PROFESSOR C. O. RIDENOUR

Engl. Lit. 505. The American Short Story (3) Lecture 3 hours.
PROFESSOR W. L. WERNER

Engl. Lit. 506. History of American Poetry (3) Lecture 3 hours.
PROFESSOR W. L. WERNER

Engl. Lit. 507. Research Problems in English (1-6) The methods of research in English, the problems of bibliography, and the method of evaluating sources and materials. Lecture 1 to 6 hours.

Engl. Lit. 508. Beowulf (3) A reading of the text and a study of the prominent literary problems and relationships. Prerequisite: Engl. Lit. 31. Lecture 3 hours. PROFESSOR D. S. MEAD

Engl. Lit. 509. Nondramatic Writers of the Elizabethan Period: The Prose Writers (3) PROFESSOR D. S. MEAD

Engl. Lit. 510. Nondramatic Writers of the Elizabethan Period: The Poets (3)
PROFESSOR A. P. LOCKLIN

Engl. Lit. 511. Elizabethan Drama (3) Lecture 3 hours.

Engl. Lit. 512. History of the American Novel (3) Lectures and reports. Lecture 3 hours. PROFESSOR W. L. WERNER

Engl. Lit. 513. American Essays (3) Lectures and reports on a special group of essayists. Lecture 3 hours. PROFESSOR W. L. WERNER

Engl. Lit. 514. Shakespeare (3) Special problems in the works of Shakespeare. Lecture 3 hours.

Engl. Lit. 515. The Age of Swift (3) Special studies varying from year to year. Lecture 3 hours. PROFESSOR C. O. RIDENOUR

Engl. Lit. 516. The Age of Johnson (3) The work of Johnson and his circle. Lecture 3 hours. PROFESSOR D. S. MEAD

Engl. Lit. 517. Byron, Shelley, and Keats (3) PROFESSOR C. O. RIDENOUR

Engl. Lit. 518. Pre-Romantic Writers (3) Development of Romantic ideas in the eighteenth century.

Engl. Lit. 519. Wordsworth, Coleridge, Southey, and Scott (3) PROFESSOR C. O. RIDENOUR

Engl. Lit. 520. Prose Writers of the Romantic Period (3) PROFESSOR C. O. RIDENOUR

Engl. Lit. 531. Old English (3) Old English language and literature with lectures on Old English and Germanic philology. PROFESSOR D. S. MEAD

Engl. Lit. 532. Middle English (3) Middle English language and literature with lectures on the development of Old English through Middle English to modern times. PROFESSOR D. S. MEAD

Engl. Lit. 533. Literary Criticism (3) An historical survey of the principles of literary criticism. PROFESSOR D. S. MEAD

Engl. Lit. 540. Chaucer (3) Analysis of Chaucer's poetry in the light of its background, sources, and subsequent influences. PROFESSOR D. S. MEAD

Engl. Lit. 543. Cavalier and Anglican (3) The poetry and prose of the middle years of the seventeenth century from the death of Shakespeare to 1660. PROFESSOR D. S. MEAD

Engl. Lit. 544. Restoration Literature (3) Selected studies in the writers in England between 1650 and 1700.

Engl. Lit. 545. The Pre-Raphaelites (3) PROFESSOR MASON LONG

Engl. Lit. 546. Tennyson and Browning (3) PROFESSOR MASON LONG

Engl. Lit. 547. Carlyle, Ruskin, and Arnold (3) PROFESSOR MASON LONG

Engl. Lit. 550. Selected Studies in the British Novel to 1840 (3) PROFESSOR T. D. BOWMAN

Engl. Lit. 551. Selected Studies in the British Novel from 1840 to the Present (3) PROFESSOR A. B. SUTHERLAND

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Engl. Lit. 400. Teachers' Course in Literature (3) PROFESSOR D. K. MERRILL

Engl. Lit. 401. Main Currents in American Literature (3) PROFESSOR D. K. MERRILL

Engl. Lit. 423. Forms and Movements of British Literature (3) PROFESSOR C. O. RIDENOUR

Engl. Lit. 439a,b,cS. Our Contemporaries (3)

Engl. Lit. 440a,b,cS. Masters of Literature (1-3)

Engl. Lit. 441a,b,cS. Masters of English Literature (1-3)

Engl. Lit. 460, 460X. Literary Biography (3) PROFESSOR D. K. MERRILL

Engl. Lit. 464. Spenser (3) PROFESSOR A. P. LOCKLIN

Engl. Lit. 475a,b,cS. World Literature in English (3-9)

Engl. Lit. 484, 484X. American Drama (3) PROFESSOR A. C. CLOETINGH

Engl. Lit. 485. Scandinavian Drama (3) PROFESSOR A. C. CLOETINGH

Engl. Lit. 486. Later British and Irish Dramatists (3) PROFESSOR A. C. CLOETINGH

Engl. Lit. 487. Modern Continental Drama (3) PROFESSOR A. C. CLOETINGH

Engl. Lit. 489a,b,cS. Composite Course in Drama (3-9)

Engl. Lit. 489dS. Contemporary Drama (3)

ENTOMOLOGY

PROFESSOR EDWARD H. DUSHAM, M.S., Ph.D.

Head of the Department of Zoology and Entomology

Ent. 500. Insect Histology (5) The microscopic structure of insect tissues and organs. Prerequisites: Ent. 2, 5, Zool. 31. Lecture 2 hours, practicum 7½ hours. Fee $5. PROFESSOR G. B. NEWMAN

Ent. 501. Medical Entomology (3) The role played by insects in the causation and transmission of disease. Prerequisites: Ent. 2, Zool. 432. Lecture 2 hours, practicum 3 hours. Fee $4.

Ent. 502. The Lepidoptera (3) The morphology, taxonomy, and relationships of the lepidoptera. Prerequisites: Ent. 2, 3, 5. Practicum 9 hours. Fee $3. PROFESSOR H. M. TIETZ

Ent. 503. The Coccidae (3) A laboratory course dealing with the identification of this important group of insects; practice in the preparation of permanent mounts for study. Prerequisites: Ent. 2, 3, 5. Practicum 9 hours. Fee $4.50. PROFESSOR E. H. DUSHAM

Ent. 505. Advanced Morphology of Insects (3) Advanced work in either the external or internal morphology of insects. Prerequisite: Ent. 500. Practicum 9 hours. Fee $10.

Ent. 506. Immature Insects (2) The morphology and taxonomy of the immature stages of insects. Prerequisites: Ent. 2, 3, 5. Practicum 6 hours. Fee $3. PROFESSOR S. W. FROST

Ent. 508. The Biological Control of Insects (2) The artificial use of bacteria, fungous diseases, and animals in the control of injurious insects; methods and equipment for rearing parasites and predators on a large scale. Prerequisites: Ent. 2, 4, 6, 8, 407. Lecture 2 hours. PROFESSOR S. W. FROST

Ent. 509. Entomological Technique (2) For advanced students dealing with special methods of collecting, rearing living insects, preparing and preserving immature stages, keeping records, and preparing illustrations for manuscript. Prerequisite: Ent. 4 or 6. Lecture 2 hours. PROFESSOR S. W. FROST

Ent. 510. The Diptera (3) The morphology, taxonomy, and relationships of the diptera. Prerequisites: Ent. 2, 3, 5. Practicum 9 hours. Fee $3. PROFESSOR S. W. FROST

Ent. 511. The Orthoptera (3) The morphology, taxonomy, and relationships of the orthoptera. Prerequisites: Ent. 2, 3, 5. Practicum 9 hours. Fee $3.

Ent. 528. Insect Physiology (2) The normal functions of the insect body. Prerequisites: Ent. 2, 5, Zool. 41. Lecture 2 hours. PROFESSOR L. E. DILLS

Ent. 534. Insect Embryology (2) The origin and development of the tissues and organs of insects. Prerequisite: Ent. 500. Lecture 2 hours.
PROFESSOR G. B. NEWMAN

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Ent. 407. Insect Ecology (2) PROFESSOR S. W. FROST
Ent. 413. Entomology Seminar (1 per semester) PROFESSOR S. W. FROST
Ent. 429. Principles of Insect Control (2) PROFESSOR S. W. FROST

FORESTRY

PROFESSOR VICTOR A. BEEDE, B.A., M.F.
Head of the Department

For. 500. National and State Administration (3-5) Comparison of the policy and administration of the national forests with the forests of other countries and of the different states. Lecture 1 hour, practicum 5 to 10 hours.
PROFESSOR V. A. BEEDE

For. 502. Wood Fibers (3-5) Identification and physical and chemical characteristics of wood fibers used for pulp, either for paper or as a source of cellulose. Pulping quality, fiber measurements. Lecture and practicum.
PROFESSOR W. E. WHITE

For. 504. Research Methods in Forestry (2-4) Review of methods employed in conducting forestry research. Recitation, conferences, practicum.
PROFESSOR W. C. BRAMBLE

For. 505. Research Methods in Forestry (2-4) A continuation of For. 504.
PROFESSOR W. C. BRAMBLE

For. 508. Forest Ecology (2-4) The organization, development, and classification of forest communities. PROFESSOR W. C. BRAMBLE

For. 509. Covert Management (2) Management of forest associations for maintenance and development of wildlife. Prerequisite: For. 508.
PROFESSOR W. C. BRAMBLE

For. 510. Seminar (1-2 per semester) Current problems of forest research presented as weekly seminar reports. May be repeated with additional credit for each semester's work. PROFESSOR V. A. BEEDE AND STAFF

For. 530. Research in Wood Utilization (3-6 per semester) Research in some chosen phase of wood utilization or forest products. Prerequisite: For. 431. Lecture and practicum hours to be arranged. PROFESSOR N. A. NORTON

For. 531. Structural Uses of Wood and Wood Products (3-6 per semester) Wood as a construction material; testing techniques for structural timbers and wood assemblies; use of laminated wood, ring connectors, and other types of special construction. Prerequisite: For. 404. Lecture and practicum hours to be arranged. PROFESSOR N. A. NORTON

For. 532. Laminates (3-6 per semester) Advanced and special studies in the fabrication and use of plywood, laminated wood, paper-base laminates, and wood-to-metal bonding. Prerequisite: For. 405. Lecture and practicum hours to be arranged. PROFESSOR N. A. NORTON

For. 535. Conditioning Treatments for Wood (3-6 per semester) Advanced study and problems in preservative, seasoning, and other special treatments for wood and wood products. Prerequisite: For. 435. Lecture and practicum hours to be arranged. PROFESSOR N. A. NORTON

For. 550. Forest Mensuration (2-8 per semester) Research in some chosen field. Prerequisite: For. 450. Lecture, conferences, practicum.
PROFESSOR H. A. MEYER

For. 560. Forest Management (3-8) Special topics in forest management and research in some chosen field. Prerequisite: For. 466. Hours to be arranged.
PROFESSOR H. A. MEYER

For. 575. Applications of Forest Economics and Finance (3 per semester) Survey of situations in forestry where business problems and particular circumstances of production, value, and costs are currently significant. Prerequisite: For. 70. Hours to be arranged. PROFESSOR M. W. HUMPHREY

For. 590. The Lumber Industry (2-4) The relation of the lumber industry to national economy and world trade; lumbermen's associations; lumber accounts. Prerequisite: For. 430. Lecture 2 to 4 hours.
PROFESSOR W. G. EDWARDS

For. 591. Problems in Lumbering (2-6) Research in some chosen phase of lumbering. Prerequisite or concurrent: For. 590. Lecture and practicum hours to be arranged. PROFESSOR W. G. EDWARDS

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

For. 400. Advanced Silviculture (2) PROFESSOR W. C. BRAMBLE
For. 402. Forest Research (2) PROFESSOR W. C. BRAMBLE
For. 404. Mechanical Properties of Wood (3) PROFESSOR N. A. NORTON
For. 405. Veneer and Plywood (3) PROFESSOR N. A. NORTON
For. 406. Forestry Literature (1) PROFESSOR V. A. BEEDE AND STAFF
For. 417. National and State Forest Practice (2) PROFESSOR V. A. BEEDE
For. 421. Regional Silviculture (4) PROFESSOR H. N. COPE
For. 427. Forest Uses (3) PROFESSOR W. C. BRAMBLE
For. 430. Forest Products and Industries (3) PROFESSOR N. A. NORTON
For. 431. Advanced Utilization (2-4) PROFESSOR N. A. NORTON
For. 435. Seasoning and Preservation (3) PROFESSOR N. A. NORTON
For. 445. Improvements (3) PROFESSOR W. G. EDWARDS
For. 446. Forest Park Administration (3) PROFESSOR W. G. EDWARDS
For. 450. Advanced Mensuration (2) PROFESSOR H. A. MEYER
For. 451. Statistics in Forestry and Wood Utilization (3)
PROFESSOR H. A. MEYER
For. 462. Advanced Wood Technology (2) PROFESSOR W. E. WHITE
For. 466. Forest Management and Management Plans (4)
PROFESSOR H. A. MEYER
For. 468. Silvicultural Research (2-4) PROFESSOR W. C. BRAMBLE
For. 469. Problems in Forest Management (3) PROFESSOR H. A. MEYER
For. 475. Problems in Forest Economics and Finance (3)
PROFESSOR M. W. HUMPHREY

For. 480. Policy and Administration (3) — Professor V. A. Beede
For. 491. Lumbering (3) — Professor W. G. Edwards
For. 492. Lumber Distribution (3) — Professor W. G. Edwards
For. 494. Logging (3) — Professor W. G. Edwards
For. 495. Milling (3) — Professor W. G. Edwards
For. 497. Small Sawmills (3) — Professor W. G. Edwards

FRENCH

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

(Academic Year)

Fr. 551. Romance Philology (3) Historical development of the Romance languages. Recitation 3 hours.

Fr. 552. Old and Middle French Readings and Literature (3) Aims at familiarizing the student with Old and Middle French texts from the earliest monument to Villon. Prerequisite: Fr. 551. Recitation 3 hours.

Fr. 553. French Literature of the Renaissance (3) The French Renaissance from 1498 to 1548. Lectures, discussions, and reports. Recitation 3 hours.

Fr. 554. French Literature of the Renaissance (3) The French Renaissance from 1548 to 1594. Lectures, discussions, and reports. Recitation 3 hours.

Fr. 557. French Romantic Poetry (3)

Fr. 562. French Thinkers of the Eighteenth Century (3) Recitation 3 hours.

Fr. 564. French Romanticism (3) The French Romantic Movement after 1830. Lectures, discussions, and reports. Recitation 3 hours.

Fr. 570. Voltaire and Rousseau (3)

Fr. 571. Seminar in French Literature (3) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor. Recitation 3 hours.

Fr. 572. Seminar in French Literature (3) A continuation of Fr. 571. Recitation 3 hours.

Fr. 573. Research in French Literature (3) In addition to the regular courses there will be an opportunity for students adequately prepared to earn from one to three credits through research.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fr. 401, 401X. French Theater of the Classical Period (3)

Fr. 402. French Theater of the Classical Period (3) A continuation of Fr. 401.

Fr. 403. French Dramatic Literature of the Eighteenth Century (3)

Fr. 405. French Drama of the Nineteenth Century (3)

Fr. 406. French Drama of the Nineteenth Century (3)

Fr. 407. French Novel of the Nineteenth Century (3)

Fr. 408. French Novel of the Nineteenth Century (3)

Fr. 410. French Contemporary Poetry (3)

Fr. 413. Contemporary French Drama (3)

Fr. 414. Contemporary French Drama (3)

Fr. 415. French Novel of the Eighteenth Century (3)

Fr. 425. Professional Translating from French into English (3)

(Main Summer Session)

Fr. 505S. The Great Writers of France: Balzac (2)

Fr. 507S. La Fontaine and His Time (2)

Fr. 528S. French Lyric Poetry of the Nineteenth Century (2)

Fr. 531S. French Novelists of the Romantic School (2)

Fr. 538S. The Romantic Poets (2)

Fr. 540S. Contemporary French Drama (2)

Fr. 541S. Modern French Drama (2)

Fr. 542S. The French Short Story of the Nineteenth Century (2)

Fr. 555S. Victor Hugo and His Time (2)

Fr. 556S. Charles Baudelaire (2)

Fr. 557S. French Romantic Poetry (2)

Fr. 559S. France Between Two Wars (2)

Fr. 560S. Moliére and the Classical Comedy (2)

Fr. 565S. French Literature of the Nineteenth Century (2)

Fr. 566S. Classical French Literature (2)

Fr. 567S. The French Novel from 1870 to 1914 (2)

Fr. 568S. The Contemporary Novel (2)

Fr. 570S. Voltaire and Rousseau (2)

Fr. 573S. Research in French Literature (1-3)

Fr. 575S. Advanced Phonetics (2)

Fr. 576S. Composition and Stylistics (2)

Fr. 577S. Advanced Composition and Stylistics (3-6)

Fr. 579S. Research Laboratory in Phonetics (1)

Fr. 587S. French Novelists of the Eighteenth Century (2)

Fr. 588S. French Poetry: from Baudelaire to the Symbolists (2)

Fr. 591S. French in the Secondary Schools (3)

Fr. 592S. French and Spanish in the Secondary Schools (3)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fr. 409S. Advanced Course in Pronunciation and Conversation (2)

Fr. 469S. French Civilization of the Nineteenth Century (2)

Fr. 490S. Grammar and Composition (3)

Fr. 493S, 493X. Elementary Phonetics (2)

Fr. 495S. Advanced Composition and Syntax (3)

Fr. 498S. Intermediate Phonetics (2)

FUEL TECHNOLOGY

PROFESSOR C. C. WRIGHT, Ph.D.
Chief of the Division

Fuel T. 501. Coal Petrography (2) The microscopic examination of coals for the determination of coal type and vegetable origin. Prerequisite or concurrent: Fuel T. 503. Practicum 6 hours. PROFESSOR C. R. KINNEY

Fuel T. 502. Research Data (3) Methods of obtaining and interpreting research data; designed for the graduate student beginning laboratory research. Prerequisite: Math. 30. Lecture 3 hours. PROFESSOR R. F. NIELSEN

Fuel T. 503. Chemical Constitution and Scientific Classification of Coal (3-6) The chemistry of plant constituents in relation to coal and the coalification process; constitution of coal as deduced by chemical methods; scientific classification of coals. Prerequisite: Chem. 31. PROFESSOR C. R. KINNEY

Fuel T. 504. Fuel Technology Research (1-15 per semester) Original research on preparation, carbonization, processing, utilization, or constitution of fuels. Results of the investigation may be used as the thesis. Prerequisites: Fuel T. 502, 503. Fee $2 per credit. PROFESSOR C. C. WRIGHT AND STAFF

Fuel T. 505. Physico-Chemical Properties of Coal, Mineral Matter, and Ash (3) The physical, physico-chemical, and use properties of coals, mineral matter, and coal ash; their significance and application in the preparation and use of coals; ash fusibility, clinker formation, and slagging. Prerequisite: Chem. 41. Lecture 3 hours. PROFESSOR J. D. CLENDENIN

Fuel T. 506. Advanced Combustion (3) Advanced combustion and heat balance calculations, ignition and flame characteristics of fuels; furnace atmospheres; selection of fuels with reference to use and equipment. Prerequisite: Chem. 41. Lecture 3 hours. PROFESSOR C. C. WRIGHT

Fuel T. 507. Advanced Thermal Processing (3) Pyrolysis of carbon compounds; coal carbonization methods and economics; significance of rank and composition in thermal processing and utilization; metallurgical and gas making coke requirements and properties; process control. Prerequisites: Chem. 35, 41, or Min. Prep. 410. Lecture 3 hours.
PROFESSOR J. D. CLENDENIN

Fuel T. 508. Synthesis of Liquid Fuels (3) The chemical nature of liquid fuels, lubricating oils, and hydrocarbons of synthetic processes; preparation of hydrogen and synthesis gas; hydrogenolysis of pure compounds, oils, tars, and coal; theoretical aspects of Fischer-Tropsch and related processes. Prerequisites: Chem. 31, Fuel T. 402. Lecture 3 hours.
PROFESSOR H. B. CHARMBURY

Fuel T. 509. Technology of Tars (3) Theories of tar formation; chemical constitution of tars and their physical and chemical properties; methods of separation, refining, and purification; uses of tars and tar products. Coal, oil, and water-gas tars are considered. Prerequisite: Chem. 31. Lecture 3 hours.
PROFESSOR T. S. POLANSKY

Fuel T. 510. Fuel Technology Problem (1-6 per semester) Special problems in fuel technology. Prerequisite: Fuel T. 503.
PROFESSOR C. C. WRIGHT AND STAFF

Fuel T. 511. Fuel Technology Seminar (1-6) Selected topics from current fuel technology research examined and discussed. Prerequisite: Chem. 35 or 41. PROFESSOR C. C. WRIGHT AND STAFF

In additon to these courses, the following may be taken for graduate credit under the restrictions in force:

Fuel T. 400. Fuel Technology Research and Design (3) Fee $3 per credit.
PROFESSOR C. C. WRIGHT AND STAFF

Fuel T. 401. Fuel Gases and Gasification (3)
PROFESSORS C. C. WRIGHT, H. B. CHARMBURY

Fuel T. 402. Chemical Processing of Fuels (2)
PROFESSOR H. B. CHARMBURY

Fuel T. 403. Energetics of Fuel Technology (3) PROFESSOR A. W. GAUGER

Fuel T. 404. Fuel Technology Design (3) PROFESSOR T. S. SPICER

GEOGRAPHY

PROFESSOR E. WILLARD MILLER, Ph.D.
Chief of the Division

Geog. 503. Advanced Regional Geography (3-12) Intensive study at an advanced level of selected regions or sections of the continents. Lectures, reports, and discussion. Prerequisite: 12 credits in geography.
PROFESSORS E. W. MILLER, G. F. DEASY

Geog. 504. Physical Geography Seminar (3-12) The literature of some phase of physical geography with emphasis on procedures for organizing material for classroom reports and discussions. PROFESSORS E. W. MILLER, G. F. DEASY

Geog. 505. Economic Geography Seminar (3-12) The literature of some phase of economic geography with emphasis on procedures for organizing material for classroom reports and discussions. PROFESSOR E. W. MILLER

Geog. 506. Cultural and Political Geography Seminar (3-12) The literature of some phase of cultural and political geography with emphasis on procedures for organizing material for classroom reports and discussions.

Geog. 510. Physical Geography Research (3-10) Original study in some phase of physical geography. This may be a field problem or a problem which requires detailed library investigation together with analysis and presentation of data and statistics. Results of investigation may form basis for thesis.
PROFESSOR G. F. DEASY

Geog. 511. Economic Geography Research (3-10) Original study in some phase of economic geography research. This may be a field problem or a problem which requires detailed library investigation together with analysis and presentation of data and statistics. Results of investigation may form basis for thesis. PROFESSOR E. W. MILLER

Geog. 512. Cultural and Political Geography Research (3-10) Original study in some phase of cultural and political geography research. This may be a field problem or a problem which requires detailed library investigation together with analysis and presentation of data and statistics. Results of investigation may form basis for thesis.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Geog. 400. Regional Geography of North America (3)
PROFESSOR G. F. DEASY

Geog. 401. Regional Geography of Pennsylvania (3) PROFESSOR E. W. MILLER

Geog. 402. Regional Geography of Middle America (3)

Geog. 403. Regional Geography of South America (3)

Geog. 405. Cultural Geography (3)

Geog. 433. Regional Climatology (3) PROFESSOR G. F. DEASY

Geog. 435. Field Methods in Geography (3) Fee $2. PROFESSOR E. W. MILLER

Geog. 442. Geography of Europe (3) PROFESSOR E. W. MILLER

Geog. 443. Geography of Asia (3) PROFESSOR G. F. DEASY

Geog. 444. Geography of Africa (3)

Geog. 445. Geography of the Air Age (3) PROFESSOR E. W. MILLER

Geog. 452. Aerial Photogrammetry (3) Fee $2. PROFESSOR E. W. MILLER

Geog. 460. Political Geography (3)

Geog. 480. Industrial Geography (3) PROFESSOR E. W. MILLER

GEOLOGY

PROFESSOR FRANK M. SWARTZ, Ph.D.

Chief of the Division

***Geol. 500. Geology Seminar (1-3)** An intensive study of any one of the following, chosen by the student: coal, oil and gas, clays, ore deposits, historical geology, metamorphic and structural geology and paleontology. Lecture 3 hours.

†**Geol. 501. Stratigraphy (3-12)** Stratigraphic principles, with particular reference to the outstanding problems of North American geology. Lecture 2 hours, practicum 3 hours. PROFESSOR F. M. SWARTZ

‡**Geol. 502. Geological Research (3-18)** An original and individual investigation of a geological problem approved by the chief of the division. This problem may be chosen from any of the main branches of geology and will involve field and laboratory study accompanied by assigned readings. Results of the investigation may be used for the thesis. Fee $2 per credit.

Geol. 503. Paleontology (3-9) PROFESSOR F. M. SWARTZ

§**Geol. 504. Advanced General Geology (3-6)** The history of geology followed by a comparison of classical and modern geologic concepts as applied to the more fundamental problems of volcanism, magmatic intrusion, sedimentation, diastrophism, geotectonics, and metamorphism. Prerequisite: graduate standing in geology. Lecture 3 hours. PROFESSOR P. D. KRYNINE

Geol. 505. Paleogeography (3-4) Identification of the geography and relief of the past and reconstruction of ancient climates by methods of sedimentary petrography. Prerequisite: Min. 485. Lecture 3 hours. PROFESSOR P. D. KRYNINE

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*Credits to be arranged, 1-3 per semester.
†Credits to be arranged, 3-6 per semester.
‡Credits to be arranged, 3-9 per semester.
§Credits to be arranged, 3 per semester.

§**Geol. 506. Ore Deposits (3-6)** An advanced study of the fundamental theories of ore deposition; critical examination of those factors which control locus and extent of mineralization; interpretation of criteria by which geologic processes are recognized and their significance evaluated. Prerequisite: Geol. 482. Lecture 2 hours, practicum 3 hours. PROFESSOR W. M. MYERS

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Geol. 451. Economic Geology (3) Fee $1.

Geol. 461. Physiography of the United States (3) Fee $1. PROFESSOR C. W. ROBINSON

Geol. 464. Paleontology (3) Fee $1.50. PROFESSOR F. M. SWARTZ

Geol. 481. Geology of Oil and Gas (3)

Geol. 482. Metallic Mineral Deposits (3) PROFESSOR W. M. MYERS

Geol. 483. Structural Geology (3) Fee $4.50. PROFESSOR F. M. SWARTZ

Geol. 484. Paleozoic Stratigraphy (3) PROFESSOR F. M. SWARTZ

Geol. 485. Paleontology (2) Fee $1.50. PROFESSOR F. M. SWARTZ

Geol. 486. Stratigraphic Methods (1) Fee $5. PROFESSOR F. M. SWARTZ

Geol. 488. Earth Sciences Seminar (1)

Geol. 489. Earth Sciences Report (1)

GEOPHYSICS AND GEOCHEMISTRY

PROFESSOR S. J. PIRSON, M.C.E., M.S., D.Sc.
Chief of the Division

Geophys. 500. Geophysical Seminar (1-3) Discussion of geophysical reports and papers; scientific outlook. Prerequisites: Geophys. 401, 402. Lecture 1 to 3 hours. PROFESSOR S. J. PIRSON

Geophys. 501. Geophysical Research (3-12) Research work in theoretical and applied geophysics; especially the branches of the seismology and geophysical methods of exploration. Practicum 3 hours per credit. Fee $2 per credit. PROFESSOR S. J. PIRSON

Geophys. 502. Selected Chapters of Advanced Geophysics (2) Lecture, review, and discussion of current problems in geophysics; topics not covered in Geophys. 401, such as seismological theory, geological effects of geophysical events. Given alternate years. Prerequisite: Geophys. 401. Lecture 2 hours. PROFESSOR S. J. PIRSON

Geophys. 503. Geophysical Surveys (3-6) An advanced course in the theory of geophysical methods of exploration and interpretation of data. Prerequisites: Geophys. 402, Math. 100. Lecture and practicum 3 to 18 hours. Fee $2 per credit. PROFESSOR S. J. PIRSON

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Geophys. 401. Mineral Geophysical Prospecting (3) Fee $5. MR. L. O. BACON

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§Credits to be arranged, 3 per semester.

Geophys. 402. Petroleum Geophysical Prospecting (4) Fee $5.
PROFESSOR S. J. PIRSON

Geophys. 403. Geophysics Field Work (3) Summer practicum. Fee $10.
PROFESSOR S. J. PIRSON

Geophys. 404. Geophysical Prospecting Problems (3) Fee $5.
PROFESSOR S. J. PIRSON

Geophys. 405. Introductory Geophysics (3) PROFESSOR S. J. PIRSON

Geophys. 406. Introductory Geochemistry (3) PROFESSOR S. J. PIRSON

GERMAN

PROFESSOR PHILIP A. SHELLEY, M.A., Ph.D.
Head of the Department

Ger. 501. German Language Seminar (3-9) Critical study of special problems in the Germanic languages, with emphasis on Gothic and the High German dialects in different eras. Papers.

Ger. 515. German Literature Seminar (3-9) Special aspects and characteristics of individual writers and various types of literature, with reference to the political, economic, social, and religious conditions of the times and to significant geographical and ethnological factors. Discussions, papers.

Ger. 524. Intensive Study of the Life and Works of Goethe (3) Various phases of the poet's life and individual works. Lectures, discussions, papers. Recitation 3 hours. PROFESSOR A. F. BUFFINGTON

Ger. 531. Special Studies in the German Lyric (3) Special aspects of the German lyric, including groups, such as the Göttinger Hainbund; movements, such as Romanticism; and poets, such as Walther von der Vogelweide, Goethe, Hölderlin, Eichendorff, Heine, Mörike, George, Hofmannsthal, and Rilke. Lectures, discussions, papers. Recitation 3 hours. PROFESSOR P. A. SHELLEY

Ger. 532. Special Studies in the German Drama (3) Special phases of the German drama, with attention to types; emphasis upon such writers as Hans Sachs, Lessing, Goethe, Schiller, Kleist, Grillparzer, Büchner, Hebbel, Hauptmann, Hofmannsthal, etc. Lectures, discussions, papers. Recitation 3 hours. PROFESSOR HELEN ADOLF

Ger. 533. Special Studies in the German Short Story (3) Emergence and development of the short story as a literary form in Germany, treating different features of the Novelle and the Kurzgeschichte from Goethe to contemporary writers. Lectures, discussions, papers. Recitation 3 hours.
PROFESSOR HERBERT STEINER

Ger. 534. Special Studies in the German Novel (3) Particular phases of the German novel, especially of the Bildungsroman, from its beginnings to the present; novels of the 17th century, such as Grimmelshausen's Simplicissimus, and those by succeeding writers, such as Wieland, Goethe, Jean Paul, Novalis, Keller, Fontane, Thomas Mann, Ricarda Huch, Kafka, and Werfel. Lectures, discussions, papers. Recitation 3 hours. PROFESSOR HELEN ADOLF

Ger. 551. Middle High German (3) Extensive reading of texts; characteristics of the various dialects. Lectures, discussions, papers. Recitation 3 hours.
PROFESSOR A. F. BUFFINGTON

Ger. 552. Old High German (3) Essentials of the grammar, with special treatment of the High German sound shift and of ablaut and umlaut. Reading of works written before 1100 A.D. Papers. Recitation 3 hours.
PROFESSOR A. F. BUFFINGTON

Ger. 553. Gothic (3) Essentials of the grammar; reading of Ulfilas' Bible translation. Suitable also for advanced students in English. Papers. Recitation 3 hours. PROFESSOR HELEN ADOLF

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Ger. 400. Proseminar in Bibliography and Methods of Research (2)
PROFESSOR P. A. SHELLEY

Ger. 401. History of the German Language (3)
PROFESSOR A. F. BUFFINGTON

Ger. 421. German Literature in the 18th Century (3)
PROFESSOR A. F. BUFFINGTON

Ger. 422. German Literature in the 19th Century (3)
PROFESSOR HELEN ADOLF

Ger. 423. German Literature of the 20th Century (3)
PROFESSOR HERBERT STEINER

Ger. 443. Literary Relations of Germany with England and America (3)
PROFESSOR P. A. SHELLEY

GREEK

PROFESSOR ROBERT E. DENGLER, A.M., Ph.D.

Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

Greek 500. Greek Composition (2) Translation of extended narrative passages into Attic Greek; a thorough review of forms and syntax; attention to the rhetorical elements of the language. Recitation 2 hours.
PROFESSOR R. E. DENGLER

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

Greek 411S. Essentials of Greek (3)

Greek 421. Greek Tragedy (3) PROFESSOR R. E. DENGLER

Greek 422. Greek Comedy (3) PROFESSOR R. E. DENGLER

Greek 423. Attic Orators (3) PROFESSOR R. E. DENGLER

Greek 424. Greek History or Philosophy (3) PROFESSOR R. E. DENGLER

Greek 427. New Testament Greek (3) PROFESSOR R. E. DENGLER

HEALTH EDUCATION

Consult Professor Lloyd M. Jones, M.A., Ph.D.

Health Ed. 501. Health Implications in the Growth and Development of School Children (3) New concepts of child growth; factors influencing growth and development of school children; medical inspection and examination; preschool program; early habit formations; mental hygiene; cooperation of parents, teachers, and children; educative programs. Prerequisite: Health Ed. 215. Professor A. F. Davis

Health Ed. 505. Advanced Techniques in Health Education (3) Prerequisites: Health Ed. 215, 399, Psy. 437. Professor A. F. Davis

Health Ed. 572. Tests and Measurements in Health Education (3) Critical study, evaluation, and demonstration of tests and measures of health education; statistical computations of data. Prerequisites: Phys. Ed. 490, Health Ed. 215, 399. Professor F. J. Bedenk

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Health Ed. 403. First Aid, Athletic Conditioning, and Training (3) Fee $1.50. Mr. S. P. Fogg

Health Ed. 405. Recent Developments in Public Health Education (3-6) Professor A. F. Davis

Health Ed. 406. Recent Developments in School Health Education (3) Professor A. F. Davis

Health Ed. 407. Advanced Personal and Public Health (3) Professor A. F. Davis

Health Ed. 411. Safety Education in the Schools (3) Professor C. D. Werner

Health Ed. 427. Health Factors in the Development of the Adolescent (3) Professor A. F. Davis

Health Ed. 453, 453X. Organization and Administration of Health Education (3) Professor A. F. Davis

Health Ed. 455S. Relationships of Health Education to the Exact Sciences (3)

Health Ed. 456. Advanced Techniques in Rural School Health (3)

HISTORY

Professor Burke M. Hermann, M.A.

Chairman, Administrative Committee

Hist. 500. Seminar in American History (3-6) Subject to be announced. Professors W. H. Gray, B. M. Hermann, P. S. Klein

Hist. 506. The Diplomatic Background of the World War, 1871 to 1914 (3) Prerequisites: Hist. 18, 19. Professors J. E. Gillespie, J. P. Selsam

Hist. 507. The Reform Movement in Modern England, 1832 to the Present (3) Professors J. E. Gillespie, A. G. Pundt

Hist. 508. Studies in European History, 1600-1789 (3) Professors J. P. Selsam, J. E. Gillespie

Hist. 509. The French Revolution and Napoleonic Era, 1789-1815 (3) PROFESSOR J. E. GILLESPIE

Hist. 511. Seminar in European History (3-6) PROFESSORS J. E. GILLESPIE, J. P. SELSAM, A. G. PUNDT

Hist. 512. Studies in Pennsylvania History (3-6) PROFESSOR P. S. KLEIN

Hist. 515. Studies in Southern History (3) PROFESSOR P. S. KLEIN

Hist. 520. The American Revolution, 1763-1783 (3) Prerequisites: Hist. 20, 21. PROFESSOR B. M. HERMANN

Hist. 529. Cultural History of the Early Middle Ages (3)

Hist. 532. Studies in Medieval Civilization (3)

Hist. 533. Studies in the History of the United States, 1829-1850 (3) PROFESSOR P. S. KLEIN

Hist. 534. The Civil War and Reconstruction, 1860-1877 (3) Prerequisites: Hist. 20, 21. Recitation 3 hours. PROFESSORS P. S. KLEIN, B. M. HERMANN

Hist. 536. Studies in the History of the United States, 1877-1900 (3)

Hist. 538. Studies in the History of Foreign Relations of the United States, 1492 to the Present (3)

Hist. 562. Seminar in Latin-American History (3-6) Prerequisites: Hist. 22, 23.

Hist. 563. Studies in the History of the Caribbean Area (3) Prerequisites: Hist. 22, 23. Lecture 3 hours.

Hist. 564. Mexico in the Twentieth Century (3) Prerequisites: Hist. 22, 23. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Hist. 406. History of American Labor (3)

Hist. 418. The Age of the Reformation (3) To alternate with Hist. 447. PROFESSOR J. P. SELSAM

Hist. 419, 419X. Recent European History (3) PROFESSORS J. E. GILLESPIE, K. FORSTER

Hist. 421, 421X. Recent American History (3) PROFESSORS B. M. HERMANN, K. FORSTER

Hist. 422. History of the American Frontier (3)

Hist. 423. The Formative Period of American History (3) PROFESSOR P. S. KLEIN

Hist. 437. The Middle Ages from Constantine to the Crusades (3)

Hist. 438. The Middle Ages from the Crusades to the Renaissance (3)

Hist. 441. Recent and Contemporary History of Great Britain (3)

Hist. 443. History of Modern Russia (3)

Hist. 444. Eastern Europe in Modern Times (3) PROFESSOR J. P. SELSAM

Hist. 445. The Age of Discovery (3) PROFESSOR J. E. GILLESPIE

Hist. 446. The Development of the British Empire (3) PROFESSOR J. E. GILLESPIE

Hist. 447. Economic Development of Modern Europe Since 1750 (3) To alternate with Hist. 418. PROFESSOR A. G. PUNDT

Hist. 448. Social and Cultural History of Modern Europe (3)
PROFESSOR J. P. SELSAM

Hist. 450. Economic Development of Colonial America, 1607-1783 (3) To alternate with Hist. 451. PROFESSOR B. M. HERMANN

Hist. 451. Social and Cultural History of Colonial America, 1607-1783 (3) To alternate with Hist. 450. PROFESSOR B. M. HERMANN

Hist. 452. Social and Cultural History of the United States Since 1783 (3)
PROFESSOR P. S. KLEIN

Hist. 460. Latin America and the United States (3) PROFESSOR W. H. GRAY

Hist. 461. Social and Cultural History of Latin America (3) To alternate with Hist. 460. PROFESSOR W. H. GRAY

HOME ECONOMICS

PROFESSOR GRACE M. HENDERSON, Ph.D.
Director of Home Economics

Home Ec. 500. Nutrition Seminar (3) Selected topics and recent advances in nutrition. Prerequisite: Home Ec. 402. Seminar 3 hours.
PROFESSOR INA PADGETT

Home Ec. 501. Individual Food Problems (2-6) Intensive study of specific problems in food preparation. Prerequisite: Home Ec. 434. Conference 1 hour, practicum 5 hours. Fee $3 per credit. PROFESSOR G. M. OLSON

Home Ec. 502. Problems in Institutional Administration (3-6) Individual study of problems in institutional administration. Prerequisites: Home Ec. 310, 330, 426. Lecture 2 hours; practicum, individual field work.
PROFESSOR E. A. ATKINSON

Home Ec. 503. Diet in Diseases (3) Reports and discussions of the problems of adaptation of diet to disorders of nutrition. Prerequisite: Home Ec. 402. Lecture 3 hours. PROFESSOR R. L. PIKE

Home Ec. 504. Field Work in Nutrition (2-4) Field problems planned to meet needs of individual students. Prerequisite: Home Ec. 402. Hours and problems to be arranged.

Home Ec. 505v. Practicum in Teaching Home Economics in the Secondary School (3-6) Projects in home economics education which may be carried out in the school in which the teacher is regularly employed. Conference and practicum hours to be arranged. PROFESSOR J. D. AMBERSON

Home Ec. 506, 506v, 506vX. Current Developments in Education in Relation to Home Economics (3) Opportunity for home economists to study newer developments in education. Prerequisite: one year of teaching experience in home economics. Lecture 3 hours.
PROFESSOR J. D. AMBERSON OR D. E. EKSTROM

Home Ec. 507. Research in Home Economics (credit as arranged) Original studies in the field of student's major interest. Prerequisite: graduation from four-year curriculum in home economics. Conference and practicum hours to be arranged.

Home Ec. 508. Parental Education (3) Discussion and use of methods, experiences, and programs which can be used effectively to help parents in dealing with problems of parent-child relationships. Prerequisites: Home Ec. 429, 430. Lecture 3 hours. PROFESSOR W. L. MORGAN

Home Ec. 509v, 509vX. Curriculum Workshop in Family Life Education (3) Laboratory course in problems of curriculum building; individual problems in this field; frequent individual and group conferences. Prerequisite: one year's experience in teaching home economics.
PROFESSOR J. D. AMBERSON OR H. M. HATCHER

Home Ec. 510v. The Supervision of Home Economics Teaching (2-6) For teachers of home economics desiring to qualify as city, county, or student teacher supervisors. Prerequisite: graduation from four-year teacher training curriculum and two years' teaching experience in home economics.
PROFESSOR J. D. AMBERSON, H. M. HATCHER, OR M. E. RIEGEL

Home Ec. 511. Problems in Relation to Clothing Consumption (3) Problems connected with the manufacture and consumption of clothing; interrelation of the textile and clothing trades with other industries. Prerequisite: Home Ec. 301. Lecture 3 hours. PROFESSOR R. E. GRAHAM

Home Ec. 514. Economic and Nutritional Phases of Menu Planning (2-4) Food expenditures in relation to nutritional value and income. Prerequisites: Home Ec. 402, Econ. 14. PROFESSOR E. W. W. DYE

Home Ec. 515, 515v, 515vX. The Teaching of Child Development and Family Relationships (3) Methods of selection and presentation of subject matter basic to understanding the development of children, and the attitudes, emotions, and relationships within the family. Not open to students having credit for Home Ec. 482. Prerequisite: 6 credits in child development and family relationships. PROFESSOR W. L. MORGAN

Home Ec. 516, 516v. Methods of Research in Home Economics (3) Review of problems and techniques of research in home economics. Required of all graduate students in home economics.

Home Ec. 517. Thesis (1-15) Conferences and assignments in connection with the preparation of the required thesis.

Home Ec. 518v. Evaluation in Family Life Education (3) Methods of evaluating progress toward goals in home economics education and the use of findings in program planning and revision. PROFESSOR H. M. HATCHER

Home Ec. 519. Consumer Problems (2-3) Methods of securing, evaluating, and presenting data concerning household commodities. Intended for those who teach home economics in high schools or colleges or who have charge of adult classes in this field. Prerequisite: graduation from a four-year home economics curriculum.

Home Ec. 520. Techniques in Human Nutrition Research (3) The more usual techniques employed by the research worker in human nutrition, accompanied by directed experience in their use and interpretation. Prerequisite or concurrent: Home Ec. 500. Lecture 2 hours, practicum 3 hours.

Home Ec. 521, 521v. Home Economics Education Seminar (2-3) Selected topics and recent developments in education for family living. Conferences and guidance relative to individual research problems.
PROFESSOR J. D. AMBERSON, H. M. HATCHER, OR D. E. EKSTROM

Home Ec. 522. Advanced Dress Design (3) Draping of garments difficult in type and distinctive in design; survey of literature in dress design. Prerequisites: Art 56, Home Ec. 401. Conference 1 hour, practicum 5 hours. Fee $2.
PROFESSOR A. E. BOYD

Home Ec. 523. Advanced Fitting and Pattern Study (3) Application of the principles involved in altering patterns and fitting garments to give students

freedom in designing and ability to deal with difficult fitting problems. Prerequisite: Home Ec. 201. Lecture 1 hour, practicum 5 hours. Fee $3.
PROFESSOR M. E. WESTGATE

Home Ec. 524. Economic Problems of the Household (3) Economic problems of the present-day family; special emphasis upon factors in household production, use of money income, and standards of living. Prerequisites: Home Ec. 439, Econ. 14. Lecture 3 hours. PROFESSOR M. B. ALLGOOD

Home Ec. 525, 525v. Home Economics and American Society (3) Family life education in relation to a democratic culture; emphasis upon the interrelatedness of socioeconomic problems and the American family.
PROFESSOR D. E. EKSTROM

Home Ec. 526, 526v. The Community Program in Family Life Education (2-3) Ways of discovering community needs and resources; methods in developing the community program in family living; leadership education for the lay member of the community.

Home Ec. 528. Home Management Supervision (2-3) Evaluation of objectives and techniques in the organization, supervision, and teaching of the home management house experience. Prerequisite: Home Ec. 439. Recitation 2 or 3 hours. PROFESSOR M. B. ALLGOOD

Home Ec. 530. Seminar in Foods (3-6) Readings and reports on recent findings in food research.

Home Ec. 531, 531v. Research in Home Economics Education (1-6) Investigation in home economics education. Individual conferences on research.
PROFESSOR J. D. AMBERSON, H. M. HATCHER, OR D. E. EKSTROM

Home Ec. 532, 532v. Curriculum in Family Life Education (3) Planning the school-home-community curriculum in family living in the light of the immediate social, economic, and educational outlook.

Home Ec. 534. Nutrition of Children (3) The nutritional needs of the normal child during prenatal life, infancy, and childhood. Prerequisites: Agr. Biochem. 35, Home Ec. 402. PROFESSOR INA PADGETT

Home Ec. 536. Children in Postwar Families and Communities (3) Postwar family and community situations influencing the development of children; the role of parents and teachers in helping individual children make satisfactory adjustments. Prerequisites: Home Ec. 429, 430, or 2 courses in psychology. Lecture 3 hours. PROFESSOR W. L. MORGAN

Home Ec. 537. Special Problems in Clothing and Textiles (1-6) Individual directed study, investigation, and practice in selected phases of textiles and clothing. Prerequisites: Home Ec. 102, 201. Lecture hours to be arranged.

Home Ec. 538. Tailoring (3) The construction of tailored garments for women and children from new and renovated materials. Prerequisites: Home Ec. 102, 201. Lecture 1 hour, practicum 5 hours. Fee $2.
PROFESSOR M. E. WESTGATE

Home Ec. 539. The Fashion World (3) The development of fashion throughout the ages; relationship of present-day fashions and practices to previous periods. Prerequisites: Home Ec. 102, 301. Lecture 3 hours.
PROFESSOR R. E. GRAHAM

Home Ec. 540. Seminar in Child Development (1-6) Readings and reports on recent findings in child development. Prerequisites: Home Ec. 429, 430, or Psy. 411 or 425. Lecture hours to be arranged. PROFESSOR W. L. MORGAN

Home Ec. 541. Art in the Environment (3) Approach based upon human needs with consideration of materials in the light of their use in home living. Prerequisite: Art 76 or Art Ed. 5 or Home Ec. 400. Lecture 2 hours, practicum 2 hours. Fee $3.

Home Ec. 542. Food Problems (3) Readings and discussion of selected food problems.

Home Ec. 543. Home Management in Relation to Family Living (3) Ways in which families manage; an opportunity to work with families in the solution of their management problems as a means of helping the student clarify her thinking in relation to the entire field of family management. Prerequisite: 6 credits of home management or family economics courses in home economics. PROFESSOR D. E. WIESENDANGER

Home Ec. 544. Special Problems in House Management (3) Specific management problems, such as social, financial, and material, including the development of college level teaching aids. Prerequisite: 6 credits of home management or family economics courses in home economics.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Home Ec. 400, 400X. Home Furnishing Problems (3) Fee $3. PROFESSOR A. G. GARDNER

Home Ec. 401. Dress Design (3) Fee $3. PROFESSOR A. E. BOYD

Home Ec. 402. Nutrition (4) Fee $5. PROFESSORS INA PADGETT, R. L. PIKE

Home Ec. 403. Theories and Techniques for Commercial Demonstrators (2) Fee $5. PROFESSOR E. V. HARDING

Home Ec. 404v. Home Furnishing Teaching Problems (3) Fee $2.

Home Ec. 405. Marriage and Family Relationships (3) PROFESSOR M. S. MCDOWELL

Home Ec. 406v. Teaching Aids in Family Life Education (1-4) Fee $2 per credit. PROFESSOR M. E. RIEGEL

Home Ec. 408. Equipment for Institutions (3)

Home Ec. 409. Elements of Diet in Disease (3) PROFESSOR R. L. PIKE

Home Ec. 410. Tea Room Management (3) Fee $5. MISS A. L. HUMMEL

Home Ec. 415v, 415vX. The Teaching of Homemaking (2)

Home Ec. 416v, 416vX. Administering the Homemaking Program (2)

Home Ec. 426. Institution Marketing (3)

Home Ec. 427, 427v, 427vX. Family Life Education (3) PROFESSOR M. E. RIEGEL OR D. E. EKSTROM

Home Ec. 429, 429X. Child Development (3) PROFESSOR D. J. AVERY

Home Ec. 430. Observation and Experience in Nursery School (1-4) Fee $1.50 per credit.

Home Ec. 432. Diet Therapy (3) PROFESSOR INA PADGETT

Home Ec. 434. Experimental Cookery (1-6) Fee $3 per credit. PROFESSOR G. M. OLSON

Home Ec. 437a,b,cS. School Cafeteria Problems (1-3) Units A, B, C. 1 credit per unit.

Home Ec. 438. School Cafeteria (2-4) Fee $5 if practicum is taken.

Home Ec. 439. Home Management (2) PROFESSOR M. B. ALLGOOD

Home Ec. 440, 440X. Study of Later Childhood (3) PROFESSOR D. J. AVERY

Home Ec. 441. Nursery School Organization (3)

Home Ec. 442. Resident Experience in Home Management (3) Fee equivalent of board and one-half of double room in Frances Atherton Hall.

Home Ec. 443, 443v, 443vX. Adult Homemaking Education (3)
PROFESSOR R. H. COOK

Home Ec. 444. The Art and the Crafts in the Homemaking Program (3-6) Fee $3. PROFESSOR A. G. GARDNER

Home Ec. 450. Problems in Household Equipment (1-6) Fee $2 per credit.
PROFESSOR M. B. ALLGOOD

Home Ec. 460, 460v. Recent Findings in Home Economics (2-3)

Home Ec. 461. Institution Administration (3)

Home Ec. 462. Institution Experience (3)

Home Ec. 463v. Senior Seminar (1)

Home Ec. 465v. Student Teaching (1-3)

Home Ec. 466v. Student Teaching (9)

Home Ec. 467. Food Preservation (1-2) Fee 50c.

Home Ec. 468. Family Nutrition (3) PROFESSOR INA PADGETT

Home Ec. 470. Housing the Family (2-3) PROFESSOR D. E. WIESENDANGER

Home Ec. 472. Clothing Conservation (2-3) Fee $2.

Home Ec. 473. Home Arts in the Adult Program (3) Fee $3.
PROFESSOR A. G. GARDNER

Home Ec. 474, 474v. Teaching Home Nursing (1)

Home Ec. 475. Teaching Nutrition to Boys and Girls (3)

Home Ec. 477. Family Management (3)

Home Ec. 480. Advanced Foods (3) Fee $10. PROFESSOR E. V. HARDING

Home Ec. 481. Educational Methods with Preschool Children (2)
PROFESSOR M. E. KEYES

Home Ec. 482. Education Procedures in Child Development and Family Relations (3) PROFESSOR W. L. MORGAN

HORTICULTURE

PROFESSOR WARREN B. MACK, M.S., Ph.D.
Head of the Department

Hort. 500. Ecology of Fruit Plants (3) The factors limiting the distribution and intensity of culture of fruit species and varieties, and the effect of environmental factors on cultural practices. Conference 3 hours.
PROFESSOR R. D. ANTHONY

Hort. 501. Pomology Research (2-12) A continuation of work covered in Hort. 445. A more extended study of the methods used in the more valuable contributions to pomology. Conferences and reports.
PROFESSOR R. D. ANTHONY

Hort. 503. Experimental Plant Breeding (3-6) Problems based mainly on the research work of the department, with a review of experimental methods and literature. Prerequisite: Hort. 444. Conference.
PROFESSOR R. E. LARSON

Hort. 504. Vegetable Gardening Research (2-12) To be preceded by or to accompany Hort. 424. Students are assigned minor phases of the research program of the department. Conference and reports 3 hours.
PROFESSOR M. L. ODLAND

Hort. 506. Nutrition of Fruit Plants (3-6) The student is assigned a minor phase of the research work of the department. Conferences and reports.
PROFESSOR R. D. ANTHONY

Hort. 507. Plant Breeding Research (3-6) A critical review of the breeding projects of the department, with original investigations. Prerequisite: Hort. 444. Conference and reports. PROFESSOR R. E. LARSON

Hort. 508. Nutrition of Vegetable Crops (3-6) Research of the department, with original research on assigned problems. Conference and reports.
PROFESSOR W. B. MACK

Hort. 511. Problems in Fruit Propagation (3-6) The student is assigned minor phases of the department's research program in this field. Conference and reports. PROFESSOR R. D. ANTHONY

Hort. 512. Fruit and Vegetable Storage Research (2-4) Problems in the construction and operation of common and refrigerated storage for fruits and vegetables. PROFESSORS F. N. FAGAN, W. B. MACK

Hort. 513. Research in Ornamental Horticulture (2-12) A critical study of research in floriculture or nursery practice at this and other institutions, particularly the interpretation of results. Students are assigned minor phases of the research program of the department. PROFESSOR E. I. WILDE

Hort. 514. Problems in the Propagation of Ornamental Plants (3-6) The effects of rooting media, temperature, age of wood, presence of leaves, and chemical stimuli upon the rooting response of cuttings; the optimum temperature for after-ripening and the germination of seeds; root stocks.
PROFESSOR R. P. MEAHL

Hort. 515. Ecology of Ornamental Plants (3) The interrelation of ornamental plants and their environments, with emphasis on autecology.
PROFESSOR E. I. WILDE

Hort. 517. Horticulture Seminar (1) A review of current research publications in horticulture. Each student presents one or more reviews of assigned topics. Conference 1 hour weekly.

Hort. 518. Research Problems in Landscape Horticulture (3-6) Selected problems to be assigned for original investigation in the creation, conservation, or management of planted areas. Prerequisite: Hort. 455. Lecture 2 hours, practicum hours variable. PROFESSOR J. R. BRACKEN

Hort. 519. Seminar on the Genetics of Horticultural Crops (1 per semester) A review of current research publications on the genetics of horticultural crops. Each student presents one or more reviews of literature on assigned topics. Conference 1 hour weekly.

Hort. 520. Seminar on the Breeding of Horticultural Crops (1 per semester) Each student presents one or more reviews of literature on assigned topics. Conference 1 hour weekly.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Hort. 420. Vegetable Canning Crops (3) PROFESSOR M. L. ODLAND

Hort. 423. Advanced Fruit and Vegetable Processing (3)

Hort. 424. Principles of Olericulture (3-6) PROFESSOR M. L. ODLAND
Hort. 427. Principles of Floriculture (3-6) Fee $2.
Hort. 444. Advanced Plant Breeding (3-6) Fee $1. PROFESSOR R. E. LARSON
Hort. 445. Principles of Pomology (3-9) PROFESSOR F. N. FAGAN
Hort. 453. Nursery Principles and Practice (3-6) PROFESSOR R. P. MEAHL
Hort. 454. Planting Design (3) Fee $1.50. PROFESSOR J. R. BRACKEN
Hort. 455. Planting Design (3-6) Fee $1.50. PROFESSOR J. R. BRACKEN
Hort. 460. Landscape Horticultural Projects (3-6) Fee $1.50. PROFESSOR J. R. BRACKEN
Hort. 461. Park, Cemetery, and Institutional Grounds Administration (3-6) Fee $1.50. PROFESSOR J. R. BRACKEN

HOTEL ADMINISTRATION

PROFESSOR GRACE M. HENDERSON, Ph.D.
Director of Home Economics;

PROFESSOR ESTHER A. ATKINSON, M.S.

The following courses may be taken for graduate credit under the restrictions in force:

H.A. 415. Hotel Promotion (2)
H.A. 440. Hotel Operational Liabilities (2)
H.A. 445. Hotel Organizataion and Operation (3)

INDUSTRIAL EDUCATION

PROFESSOR S. LEWIS LAND, M.S., Ph.D.
Head of the Department

Ind. Ed. 501v. Seminar in Vocational Education (1-12) Conferences, investigations, and discussion for advanced students and mature persons who have had experience as teachers, supervisors, or administrators with one or more phases of vocational education. Conference 1 to 12 hours.

UNIT A. CURRICULUM CONSTRUCTION (2-3).

UNIT B. TESTING AND GRADING (2-3).

UNIT C. VOCATIONAL TECHNICAL EDUCATION (2-3).

UNIT D. ADULT EDUCATION (2-3).

Ind. Ed. 506v, 506vX. Administration of Vocational Education (1-6) The job of the local director of industrial education with major emphasis upon matters of vital importance in organizing and developing city and other local programs of industrial education. Prerequisite: 6 semester hours in industrial education or valid director's certificate, equivalent training and experience. Lecture 2 to 6 hours.

Ind. Ed. 510v, 510vX. Vocational Education for Administrators (2-3) Designed for school administrators and supervisors who desire an understanding of the basic distinction between practical arts education and vocational education; and who wish to familiarize themselves with the underlying princi-

ples, essential philosophy, valid objectives, and accepted methods effective in organizing, supervising, and administering vocational education programs. Prerequisite: Ind. Ed. 1v or trade or teaching experience. Lecture 2 hours.

Ind. Ed. 550v. Research in Vocational Education (1-12) Research techniques in vocational education and research problems in connection with work of evening, part-time, or day vocational industrial schools.

UNIT A. RESEARCH TECHNIQUES IN VOCATIONAL INDUSTRIAL EDUCATION (2-3).

UNIT B. INDIVIDUAL RESEARCH PROBLEMS IN VOCATIONAL INDUSTRIAL EDUCATION (1-10).

Ind. Ed. 555v, 555vX. Current Problems in Vocational Education (1-6) Recent trends and developments in part-time, full-time, and evening school education, involving critical analysis of objectives, content, and outcome, together with constructive suggestions for improving current practice where possible. Lecture 3 to 6 hours.

UNIT A. CHANGING INDUSTRIAL, ECONOMIC, AND SOCIAL CONDITIONS (1).

UNIT B. POLICIES AND PROGRAM OF THE AMERICAN VOCATIONAL ASSOCIATION (1).

UNIT C. FEDERAL AND STATE VOCATIONAL LEGISLATION, PRESENT AND PENDING (1).

UNIT D. FINANCING VOCATIONAL EDUCATION (1).

UNIT E. CURRENT ADMINISTRATIVE PROBLEMS IN VOCATIONAL EDUCATION (1).

UNIT F. CURRENT ADMINISTRATIVE PROBLEMS IN VOCATIONAL EDUCATION (continued) (1).

Ind. Ed. 558v. Frontier Problems in Vocational Industrial Education (2-3 per unit)

UNIT A. FEDERAL LEGISLATION (2-3).

UNIT B. PRESENT-DAY LOCAL PERSONNEL AND CURRICULUM PROBLEMS (2-3).

UNIT C. STATE AND LOCAL SUPERVISION AND ADMINISTRATION (2-3).

Ind. Ed. 560v, 560vX. Philosophy of Industrial Education (2-3) Principles and beliefs upon which progressive industrial education rests; basic concepts underlying practical arts and vocational education; literature for evaluating instructional practices in industrial education. Prerequisite: 12 hours in industrial education or teaching experience.

Ind. Ed. 575, 575X. Problems in Industrial Arts Education (2-3) Group and individual investigations and class discussions of teaching problems of industrial arts in such areas as departmental and subject objectives, subject matter, projects, methods of manual and informational teaching, aids and devices, selection of text and reference materials, personnel organization, shop management, problem pupils, etc. Prerequisite: 12 hours of industrial education.

Ind. Ed. 576. Supervision and Administration of Industrial Arts Education (2-3) How to organize, supervise, and administer functioning programs of industrial arts; the duties of a supervisor and director of industrial arts; special problems of supervision and administration of industrial arts; relationships to local, state, and federal educational authorities; correlating industrial arts with other areas of learning. Lecture 2 or 3 hours.

Ind. Ed. 577. Testing in Industrial Arts (2-3) Construction of informal manipulative and written tests; use of standardized mechanical aptitude and

achievement tests; construction and use of rating scales; scoring and grading; interpretation of test results. Prerequisites: 6 hours in graduate courses in industrial arts and a graduate course in psychology. Lecture 2 or 3 hours.

Ind. Ed. 578. Research in Industrial Arts (1-12) The most common research techniques used in industrial arts, and individual research problems in industrial arts. Prerequisite: 6 hours in professional courses in industrial arts.

UNIT A. COMMON RESEARCH TECHNIQUES IN INDUSTRIAL ARTS (2-3).

UNIT B. INDIVIDUAL RESEARCH PROBLEMS IN INDUSTRIAL ARTS (1-10).

Ind. Ed. 579. Master's Thesis in Industrial Arts (1-6) Conferences and assignments relating to the preparation of an acceptable thesis in industrial arts for the Master of Science or Master of Education degrees. Prerequisite: 6 hours in professional courses in industrial arts.

Ind. Ed. 580, 580X. Seminar in Industrial Arts (2-9) Directed study, investigation, or research in study of selected specific fields of industrial arts. Reports and constructive criticism. Primarily for graduate students majoring in industrial arts education. Prerequisite: 12 hours in industrial education or teaching experience. Lecture 2 to 6 hours.

Ind. Ed. 590v. Master's Thesis in Industrial Education (2-6) Conferences and assignments relating to the selection and preparation of an acceptable thesis for the degree of Master of Education or of Master of Science.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Ind. Ed. 401v, 401vX. History of Industrial Education (2-3)

Ind. Ed. 402v, 402vX. Supervision of Vocational Education (2-3)

Ind. Ed. 403v, 403vX. Supervised Field Work (1-6)

Ind. Ed. 405v, 405vX. Conference Leader Training (2-3)

Ind. Ed. 407, 407X. Industrial Arts Education (2-3)

Ind. Ed. 408v, 408vX. Occupations (2-3)

Ind. Ed. 409v, 409vX. Tests and Measurements (2-3)

Ind. Ed. 410v, 410vX. Influences of Modern Industrial Life on Industrial Education (2-3)

Ind. Ed. 412v, 412vX. Special Problems in Vocational Education (2-4)

Ind. Ed. 414v, 414vX. Vocational Educational Guidance (2-3)

Ind. Ed. 415v, 415vX. Problems in Co-ordinating Vocational Education (2-3)

Ind. Ed. 418v, 418vX. Problems in Audio-Visual Aids in Industrial Education (2-3) Fee $1.

Ind. Ed. 420v, 420vX. Occupational Hygiene (2-3)

Ind. Ed. 421, 421X. Curriculum Materials in Industrial Arts (2-3)

Ind. Ed. 427v, 427vX. Advanced Course of Study Building (2-3)

Ind. Ed. 430v, 430vX. Safety Education for Vocational Teachers (2-3)

Ind. Ed. 436v, 436vX. Adult Education in Industrial America (2-3)

Ind. Ed. 446v, 446vX. Improvement of Instruction in Vocational Education (2-4)

Ind. Ed. 450v, 450vX. Shop Layout and Management (2-3)

Ind. Ed. 458v. Emerging Problems in Vocational Education (1-7)

Ind. Ed. 460. Problems in Vocational Rehabilitation of the Handicapped (1-6)

UNIT A. THE COUNSELING INTERVIEW IN VOCATIONAL REHABILITATION (1-3)

UNIT B. OCCUPATIONAL INFORMATION AND PLACEMENT TECHNIQUES IN VOCATIONAL REHABILITATION (1-3)

Ind. Ed. 470, 470X. Problems in Senior High School Industrial Arts (2-3)

INDUSTRIAL ENGINEERING

PROFESSOR CLARENCE E. BULLINGER, I.E., M.S.
Head of the Department

I.E. 501. Manufacturing Methods (2-8) Special projects including investigation, experimentation, design, and research of some one or more special types of manufacture. Seminar and practicum. PROFESSOR C. E. BULLINGER

I.E. 502. Management Methods (3) Intensive study of the newer phases of scientific management, including production control and application of Gantt charts; research on special problems. Seminar and practicum.
PROFESSOR C. E. BULLINGER

I.E. 503. Personnel Relations (2-8) Research on special topics. Seminar.
PROFESSOR C. E. BULLINGER

I.E. 505. Graphical Computation (2-10) The construction of natural and logarithmic scales, applications of various co-ordinate papers and construction of nomographic or alignment charts; determination of empirical formulae from engineering data. Seminar and practicum.
PROFESSOR M. M. BABCOCK

I.E. 506. Time and Motion Study (3) Machine data, elementary and fundamental machine times; determination of fatigue curves; design of Barth slide rules; micromotion study and chart plotting of micromotion results; chronocyclegraph study. Seminar. PROFESSOR C. A. ANDERSON

I.E. 507. Standard Costs (3) The control of the manufacturing division of an industrial enterprise through the analysis of variances between standard costs and actual costs of labor, material, and expenses. Prerequisite: I. E. 401. Seminar. PROFESSOR R. A. HUSSEY

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

I.E. 401. Industrial Accounts (4) Fee 50c. PROFESSOR R. A. HUSSEY

I.E. 404. Scientific Management (2) PROFESSOR C. E. BULLINGER

I.E. 406. Factory Planning (2) Fee $1.50. PROFESSOR M. M. BABCOCK

I.E. 409. Personnel Administration (3) PROFESSOR G. D. THOMAS

I.E. 411. Manufacturing Budgets (2) Fee 50c. PROFESSOR R. A. HUSSEY

I.E. 422a,b,c,d,e,f. Industrial Engineering Problems (2 per unit)
PROFESSORS M. M. BABCOCK, C. E. BULLINGER
C. A. ANDERSON, R. A. HUSSEY, G. D. THOMAS

I.E. 423. Quality Control (2-3) PROFESSOR C. E. BULLINGER

JOURNALISM

PROFESSOR FRANKLIN C. BANNER, M.A.
Head of the Department

The following course may be taken for graduate credit under the restrictions in force:

Journ. 430S. Supervision and Management of School Publications (3)

LATIN

PROFESSOR ROBERT E. DENGLER, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

Latin 500. Latin Literature (3) Lectures and collateral readings on the major forms of Latin literature; readings in the original Latin to supplement the lectures. PROFESSOR R. E. DENGLER

Latin 501. Roman Religion and Philosophy (3) Primitive Roman religious concepts; their growth through contact with more mature cultures; the development of philosophic thought at Rome; the social and political status of society in the Roman empire in relation to the rise of Christianity. Lectures and reports. PROFESSOR F. B. KRAUSS

Latin 502. Latin Epigraphy (3) Lectures and readings on Roman inscriptions; illustrative exercises. PROFESSOR F. B. KRAUSS

Latin 503. Latin Paleography (3) The Latin alphabet, writing materials, Roman book and cursive hands; illustrative exercises. PROFESSOR R. E. DENGLER

Latin 504. Roman Topography (3) The physical development of the city of Rome; its walls, aqueducts, bridges, streets, fora, public buildings, temples, etc.; building materials and methods of construction. Lectures and reports. PROFESSOR F. B. KRAUSS

Latin 510. Latin Seminar (3)

Latin 518. Latin Research (1-3) Prosecution of an assigned problem under the guidance of a member of the department. PROFESSOR R. E. DENGLER

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Latin 428. Lucretius: Selections from the "De Rerum Natura" (3) PROFESSOR F. B. KRAUSS

Latin 429. Quintilian: Selections from the "Institutio Oratoria" (3) PROFESSOR F. B. KRAUSS

Latin 431. Juvenal: Selections from the Satires (3) PROFESSOR F. B. KRAUSS

Latin 436S. Functional Problems in Latin (3)

Latin 440a,b,c,dS. College Latin (3-12)

LIBRARY SCIENCE

Consult LIBRARIAN WILLARD P. LEWIS, B.L.S., M.A.

The following courses may be taken for graduate credit under the restrictions in force:

Lib. Sci. 403S. Intermediate Dictionary Cataloguing and Subject Headings (2-3)

Lib. Sci. 405S. Intermediate Reference Work and Bibliography (2-3)

Lib. Sci. 422S. Intermediate Classification (2-3)

MATHEMATICS

PROFESSOR FREDERICK W. OWENS, M.S., Ph.D.
Head of the Department

Math. 500. Analytical Mechanics (3) An exposition of rigid dynamics, the potential function, and Lagrange's equations. Prerequisite: Math. 419. Lecture 3 hours.

Math. 501. Theory of Functions of a Real Variable (3) Theory of point sets; of continuous and discontinuous functions of a real variable, together with the study of their derivatives and of their integrals in both the Riemann and Lebesgue sense. Prerequisite: Math. 421. Lecture 3 hours.

Math. 502. Theory of Functions of a Real Variable (3) A continuation of Math. 501. Lecture 3 hours.

Math. 503. Fourier Series and Harmonic Functions (3) Fourier series and integrals; spherical harmonics, Bessel functions, etc., with special emphasis on their applications. Prerequisite: Math. 431.

Math. 505. Integral Equations and Their Application to Mathematical Physics (2) The solution of the equations of Fredholm and Volterra, together with their application to problems of geometry and analysis, to boundary problems in physics, etc. Prerequisite: Math. 405. Lecture 2 hours.

Math. 506. Integral Equations and Their Application to Mathematical Physics (2) A continuation of Math. 505. Lecture 2 hours.

Math. 508. Theory of Functions of a Complex Variable (3) A logical development of the complex number system and the fundamental operations of complex numbers; the theory of analytic functions of a complex variable. Prerequisites: Math. 9, 11. Lecture and exercises 3 hours.

Math. 509. Theory of Functions of a Complex Variable (3) Continuation of Math. 508. Lecture and exercises 3 hours.

Math. 510. Theory of Substitution Groups (2) The application of the theory of algebraic equations. Lecture 2 hours.

Math. 511. Introduction to Higher Algebra (3) Algebra of matrices, determinants, bilinear and quadratic forms. Prerequisites: Math. 9, 11. Lecture and exercises 3 hours.

Math. 512. Introduction to Higher Algebra (3) A continuation of Math. 511. Lecture and exercises 3 hours.

Math. 513. Advanced Analytic Geometry (3) Introduction of homogeneous co-ordinates and their use in the study of projective properties. Prerequisite: Math. 30.

Math. 514. Advanced Analytic Geometry (3) A continuation of Math. 513.

Math. 520. Projective Geometry (3) A general study of the subject from the postulational standpoint. Prerequisite: Math. 30. Lecture 3 hours. Alternate years or as required.

Math. 521. Projective Geometry (3) Continuation of Math. 520. Lecture 3 hours. Alternate years or as required.

Math. 522. Metric Differential Geometry (3) The usual classical treatment of the subject. Prerequisite: Math. 11 or 30.

Math. 523. Differential Geometry (3) A continuation of Math. 522.

Math. 524. Projective Differential Geometry (3) Study of the classic methods of Wilcznski, Lane, Fubini, etc. Prerequisite: Math. 514. Lecture 3 hours.

Math. 525. Projective Differential Geometry (3) A continuation of Math. 524. Lecture 3 hours.

Math. 526. Algebraic Geometry (3) Involutions on rational curves and related topics. Prerequisite: Math. 514. Lecture 3 hours.

Math. 527. Algebraic Geometry (3) A continuation of Math. 526. Lecture 3 hours.

Math. 530. Analysis Situs (3) Combinatorial analysis situs with application, abstract spaces, continuous curves, and the theory of dimensionality. Prerequisite: Math. 501.

Math. 531. Analysis Situs (3) A continuation of Math. 530.

Math. 532. Theory of Sets (3) Theory of abstract sets; cardinal and ordinal numbers; sets of points in Euclidean space and in general metric space; theory of measure with applications to geometry and function theory. Prerequisite: general mathematical maturity. Lecture 3 hours.

Math. 533. Theory of Sets (3) Continuation of Math. 532. Prerequisite: Math. 532. Lecture 3 hours.

Math. 534. Theory of Algebraic Numbers (3) An introduction to the number theory of quadratic fields, with a study of the theory of ideals in quadratic and higher fields, with application. Prerequisite: Math. 504.

Math. 535. Modern Algebraic Theories (3) Algebraic invariants, matrices, quadratic and Hermitian forms, Galois theory of equations, modular systems, etc. Prerequisite: general mathematical maturity. Lecture 3 hours.

Math. 536. Modern Algebraic Theories (3) A continuation of Math. 535. Lecture 3 hours.

Math. 540. Theory of Relativity (3) An introduction to the subject by a study of the Riemann Einstein space. Prerequisites: Math. 405, 417, 431.

Math. 541. Theory of Relativity (3) A continuation of Math. 540.

Math. 550. Mathematical Logic (3) The logical basis of mathematics and its ultimate nature. Prerequisite: general mathematical maturity. Lecture 3 hours.

Math. 560. Theory of Differential Equations (3)

Math. 561. Theory of Differential Equations (3) Continuation of Math. 560.

Math. 570. Special Topics in Geometry (3-6)

Math. 571. Special Topics in Analysis (3-6)

Math. 575. Mathematics Seminar (2-6) Selected topics from recent mathematical developments. Prerequisite: general mathematical maturity. Lecture 2 hours.

Math. 576. Mathematics Seminar (2-6) A continuation of Math. 575. Lecture 2 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Math. 401. College Geometry (3)
Math. 403. Modern Methods in Geometry (3)
Math. 404. Theory of Numbers (3)
Math. 405. Partial Differential Equations (3)
Math. 406. Calculus of Variations (3)
Math. 409. Theory of Probability (3)
Math. 410. Statistical Methods (3)
Math. 417. Vector Analysis (3)
Math. 419. Analytical Mechanics (3)
Math. 420. Advanced Calculus (3)
Math. 421. Advanced Calculus (3)
Math. 424. Least Squares (2)
Math. 425. Curve Fitting (1)
Math. 431. Differential Equations (3)
Math. 440. Theory of Equations (3)
Math. 441. Theory of Equations (3)
Math. 451. Introduction to Applied Mathematics (3-6)
Math. 452. Introduction to Applied Mathematics (3-6)
Math. 471. Foundations of Algebra (3)
Math. 472. Foundations of Geometry (3)

MECHANICAL ENGINEERING

PROFESSOR NORMAN R. SPARKS, B.S., M.E.
Head of the Department

M.E. 502. Advanced Gas Turbines (3-6) The thermodynamic and stress analysis design of gas turbine and compressor units. Prerequisite: M.E. 409.
PROFESSOR H. A. SORENSEN

M.E. 504. Advanced Thermodynamics (3-6) Pure and applied thermodynamics including its application to advanced engineering problems; collateral reading and discussion of the classical works on the subject. Prerequisite: M.E. 3 or 104.

M.E. 505. Heat Transmission (3-6) Applications of principles of heat transfer to efficient design of mechanical engineering equipment. Prerequisite: M.E. 412. Lecture 3 to 6 hours.
PROFESSOR A. H. ZERBAN

M.E. 506. Mechanical Engineering Seminar (1-4) Advanced courses adapted to the individual requirements of graduates in mechanical engineering. Prerequisites: M.E. 407, 410.

M.E. 507. Advanced Internal Combustion Engines (3) Design and performance of both carburetor and fuel injection type reciprocating engines primarily from the thermodynamic viewpoint, with emphasis on the economics of operation. Prerequisites: M.E. 413, 504. Lecture 3 hours.

M.E. 508. Mechanical Engineering Research (1-9) Research related to the mechanical engineering major subject; work must show evidence of original thinking; may be scheduled as thesis work for the M.S. degree.

M.E. 509. Heat Engineering Seminar (2-6) Advanced studies in design and performance of heat equipment, direct-fired and unfired; adapted to the individual requirements of graduates in mechanical engineering. Prerequisite: M.E. 6. PROFESSOR A. H. ZERBAN

MECHANICAL ENGINEERING DESIGN

M.E. Des. 502. Friction and Lubrication (2-5) The hydrodynamic theory of lubrication, and the methods of applying it to bearing design, together with a survey of methods of testing lubricants. PROFESSOR L. J. BRADFORD

M.E. Des. 505. Advanced Machine Design (2-6) Lateral and torsional vibrations in rotating and reciprocating machinery and an exact analysis of the stresses produced by these and other dynamical forces in machine parts. Prerequisite: M.E. Des. 7. PROFESSOR R. B. DAY

MECHANICAL ENGINEERING LABORATORY

M.E. Lab. 501. Investigation Projects (2-6) Special experimental studies or investigations in mechanical engineering, adapted to individual requirements. Fee $5. PROFESSORS E. E. AMBROSIUS, N. R. SPARKS

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

M.E. 401a,b,c,d. Mechanical Engineering (3-12)
PROFESSORS E. E. AMBROSIUS, L. J. BRADFORD, N. R. SPARKS, A. H. ZERBAN

M.E. 402. Air Conditioning (3) PROFESSOR C. C. DILLIO

M.E. 407. Internal Combustion Engines (3) PROFESSOR C. C. DILLIO

M.E. 408. Steam Turbines (3) PROFESSORS N. R. SPARKS, A. H. ZERBAN

M.E. 409. Gas Turbines (3)
PROFESSORS H. A. SORENSEN, N. R. SPARKS, A. H. ZERBAN

M.E. 410. Steam Power Plants (2-4) Fee $1.
PROFESSORS H. A. SORENSEN, A. H. ZERBAN

M.E. 411. Refrigeration (2-4)
PROFESSORS C. C. DILLIO, N. R. SPARKS, A. H. ZERBAN

M.E. 412. Fundamentals of Heat Transfer (3) PROFESSOR A. H. ZERBAN

M.E. 413. Internal Combustion Engines (2-4)
PROFESSORS C. C. DILLIO, H. A. SORENSEN, N. R. SPARKS

M.E. 415. Heat Transfer Processes in Commercial Manufacturing (3)
PROFESSORS H. A. SORENSEN, A. H. ZERBAN

M.E. 416. Resistance and Powering of Ships (3) PROFESSOR A. H. ZERBAN

M.E. Des. 402. Design of Machine Tools (3) PROFESSOR M. S. GJESDAHL

M.E. Des. 452. Advanced Dynamics of Machines (3) Fee $1.

METALLURGY

PROFESSOR JOHN R. LOW JR., D.Sc.
Chief of the Division

Met. 500. Metallurgical Research (3-15 per semester) Research on special topics; conferences, reading, and library work. Results may be embodied in

a thesis. Prerequisites: Met. 411, 413. Fee $2 per credit.
PROFESSOR J. R. LOW AND STAFF

Met. 501. Metallurgical Problems (1-6 per semester) Independent study of special problems in metallurgy. Prerequisites: Met. 411, 413. Practicum 3 to 18 hours. PROFESSOR J. R. LOW AND STAFF

Met. 502. Metallurgical Seminar (1 per semester) Conferences, reading, and reports. Required of all graduate students in metallurgy.
PROFESSOR J. R. LOW AND STAFF

Met. 515. Corrosion and Protection of Metallic Surfaces (3) The phenomena and theories of corrosion processes from the viewpoint of the metallurgist; the chemistry and metallurgy of metal protection by electroplating, anodizing, galvanizing, tinning, metal spraying, and other metallurgical surface treatments, in both theoretical and practical aspects. Prerequisites: Met. 411, 413. Lecture 3 hours. PROFESSOR H. J. READ

Met. 516. Mechanical Metallurgy (3) Theory of plastic flow and rupture of polycrystalline metals; the influence of combined stresses, rate of deformation and temperature variation on the flow and rupture of metals; the applications of theory to metal forming operations and the interpretation of mechanical test results. Prerequisites: Met. 411, 413. Lecture 3 hours.
PROFESSOR J. R. LOW

Met. 517. Advanced Nonferrous Metallurgy (3) Theory of chemical processes in the extractive metallurgy of the principal nonferrous metals; particular attention to electrometallurgical operations in the fields of electrowinning and electrorefining, and to processes involving the vapor phase. Prerequisites: Met. 411, 413. Lecture 3 hours. PROFESSOR H. J. READ

Met. 518. Constitution of Metallurgical Systems (3) Application of thermodynamic principles to the study of gas-metal, slag-metal, and complex alloy systems; equilibrium and rates of reaction in metal extractions and refining processes. Constitution of complex alloys. Prerequisites: Met. 411, 413. Lecture 3 hours. PROFESSOR H. M. DAVIS

Met. 519. Advanced Ferrous Metallurgy (3) Theory of the chemical processes in the smelting, refining, and deoxidation of iron and steel; slag and metal bath control methods; ingot solidification and primary forging operations, and their relation to the properties of wrought steel products. Prerequisites: Met. 411, 413. Lecture 3 hours.

Met. 520. Foundry Metallurgy (3) The principles of foundry metallurgy and their application to foundry operations for various casting alloys; specific attention to steels, cast irons, and the nonferrous metals with respect to the metallurgy and operations involved in their founding. Prerequisites: Met. 411, 413. Lecture 3 hours. PROFESSOR R. W. LINDSAY

Met. 521. Engineering Alloys (3) Ferrous and nonferrous alloys used for special purposes such as tool steels, electrical sheets, and corrosion and heat-resisting alloys; the various alloys available for each application are compared on the basis of properties and relative cost; discussion based upon the metallography and constitution of the particular alloy systems involved. Prerequisites: Met. 411, 413. Lecture 3 hours. PROFESSOR R. W. LINDSAY

Met. 522. Solid Phase Reactions in Metals (3) Mechanism and rate determining factors in solid phase reactions in metals; diffusion processes, nucleation theory, precipitation from solid solution, eutectoid decomposition and order-disorder phenomena. Prerequisites: Met. 411, 413. Lecture 3 hours.
PROFESSOR E. P. KLIER

Met. 523. Behavior of Metal Crystals (3) Plastic action in single crystals of metals and in polycrystalline metals, theoretical crystal plasticity, recovery, and recrystallization, deformation and recrystallization textures, anistropy in general. Prerequisites: Met. 411, 413. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Met. 405. Ferrous Metallography (3) Fee $10. PROFESSOR R. W. LINDSAY

Met. 406. Nonferrous Metallography (3) Fee $10. PROFESSOR H. J. READ

Met. 407. Metallurgical Engineering I (3)

Met. 408. Metallurgical Engineering II (3)

Met. 409. Metallurgical Investigations I (3) Fee $5.

Met. 410. Metallurgical Investigations II (3) Fee $5.

Met. 411. Advanced Physical Metallurgy (3) PROFESSOR J. R. LOW JR.

Met. 412. Experimental Metallurgy (3) Fee $5.

Met. 413. Advanced Chemical Metallurgy (3) PROFESSOR H. M. DAVIS

METEOROLOGY

PROFESSOR HANS H. NEUBERGER, D.Sc.
Chief of the Division

Meteor. 500. Meteorological Seminar (1-3) Discussion of meteorological reports and papers; scientific outlook. Prerequisites: Meteor. 421, 441, 451. Lecture 1 to 3 hours. PROFESSOR H. H. NEUBERGER AND STAFF

Meteor. 501. Meteorological Research (3-15) Research work in physical, synoptic, dynamic meteorology; climatology. Prerequisites: a minimum of one year of physics, calculus, and differential equations, 15 credits in meteorology. Practicum 3 hours per credit. Fee $2 per credit.
PROFESSOR H. H. NEUBERGER

Meteor. 502. Selected Topics of Advanced Meteorology (2) Lectures, review, and discussion of current problems in meteorology. Prerequisite: a minimum of 15 credits in meteorology. Lecture 2 hours.
PROFESSOR H. H. NEUBERGER AND STAFF

Meteor. 504. Theoretical and Dynamic Meteorology (3) Mathematical analysis of meteorological phenomena; theory of circulation; deformation fields. Prerequisite: Meteor. 452. Fee $1. PROFESSOR H. H. NEUBERGER

Meteor. 505. Bioclimatology (2) Climatic phenomena in their relation to life. Prerequisite: Meteor. 372. Lecture 2 hours. Fee $1.
PROFESSOR H. H. NEUBERGER

Meteor. 506. Advanced Meteorological Analysis (2-6) Physical analysis of atmospheric phenomena; synoptic analysis of weather phenomena for advanced students. Prerequisite: Meteor. 421. Lecture 1 hour, practicum 3 to 15 hours. PROFESSOR H. H. NEUBERGER AND STAFF

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Meteor. 421. Synoptic Meteorology I (3) MR. F. B. STEPHENS

Meteor. 422. Synoptic Meteorology II (3) MR. F. B. STEPHENS

Meteor. 431. Synoptic Meteorology Laboratory I (2) Fee $5.
MR. F. B. STEPHENS

Meteor. 432. Synoptic Meteorology Laboratory II (2-10) Fee $1.50 per credit.
MR. F. B. STEPHENS

Meteor. 441. Physical Meteorology I (2) PROFESSOR H. H. NEUBERGER

Meteor. 442. Physical Meteorology II (2) PROFESSOR H. H. NEUBERGER

Meteor. 451. Dynamic Meteorology I (3) PROFESSOR H. H. NEUBERGER

Meteor. 452. Dynamic Meteorology II (3) PROFESSOR H. H. NEUBERGER

Meteor. 453. Problems in Dynamic Meteorology (1)

Meteor. 492. Meteorological Seminar (2) Fee $1.

MINERAL ECONOMICS

PROFESSOR W. M. MYERS, M.S., Ph.D.
Chief of the Division

Min. Econ. 500. Marketing of Minerals and Mineral Products (3-6) Research in mineral marketing problems. Prerequisite: Min. Econ. 453.
PROFESSOR W. M. MYERS

Min. Econ. 501. Research in Mineral Economics (3-6) Investigation in specialized fields of research in mineral economics. Prerequisite: Min. Econ. 453.
PROFESSOR W. M. MYERS

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Min. Econ. 400. Seminar (1) PROFESSOR W. M. MYERS

Min. Econ. 453. Nonmetallic Minerals (3) PROFESSOR W. M. MYERS

Min. Econ. 483. The Metals and Their Ores (3) PROFESSOR W. M. MYERS

Min. Econ. 484. The Fuels (3) PROFESSOR W. M. MYERS

MINERAL PREPARATION

PROFESSOR SHIOU-CHUAN SUN, M.S., Sc.D.
Acting Chief of the Division

Min. Prep. 502. Froth Flotation and Agglomeration (3) An intensive study of the theory and applications of froth flotation and agglomeration. Prerequisite: Min. Prep. 405. Lecture 3 hours. PROFESSOR S. C. SUN

Min. Prep. 504. Mineral Preparation Research (3-10) Research work on specific problems in mineral preparation. Prerequisite: Min. Prep. 405 or 410. Practicum 9 to 30 hours. Fee $2 per credit.

Min. Prep. 505. Gravity Processes and Miscellaneous Methods of Mineral Preparation (3) An intensive study of the theory and applications of gravity, magnetic, electrostatic, centrifugal, and dense-media processes of mineral concentration. Prerequisite: Min. Prep. 405. Lecture 3 hours.

Min. Prep. 506. Mineral Preparation Plant Design (3-10) The layout, design, and selection of equipment for specific mineral preparation plant projects. Prerequisite: Min. Prep. 405. Practicum 9 to 30 hours.
PROFESSOR D. R. MITCHELL

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Min. Prep. 400. Mineral Preparation Seminar (1)

Min. Prep. 403. Flowsheets of Mineral Preparation Plants (2)

Min. Prep. 404. Plant Layout and Design (2)

Min. Prep. 405. Unit Operations (4) Fee $5.

Min. Prep. 406. Mineral Preparation Testing (2) Fee $5.

Min. Prep. 410. Coal Preparation (3) Fee $5. PROFESSOR D. R. MITCHELL

MINERALOGY

PROFESSOR PAUL D. KRYNINE, Ph.D.

Chief of the Division

Min. 500. Physical Mineralogy (3) Optical methods and measurement of optical constants of minerals. Seminar 1 hour, practicum 6 hours. Fee $6.
PROFESSORS P. D. KRYNINE, T. F. BATES

Min. 501a. Petrology (3-6) Microscopic study of rocks, emphasizing classification and genetic relationships. Seminar and practicum. Fee $2 per credit.
PROFESSORS P. D. KRYNINE, E. F. OSBORN, J. C. GRIFFITHS

***Min. 502a. Mineralogical Research** (3-18) An original study of some mineralogical problem, results of which may be applied on the thesis requirements. Fee $2 per credit.

Min. 503. Sedimentary Petrography (3) Application of the more refined methods of mechanical and microscopic analyses to the interpretation of difficult sedimentary rocks and to problems of industrial petrography. Prerequisite: Min. 485. Lecture 1 hour, practicum 6 hours.
PROFESSORS P. D. KRYNINE, J. C. GRIFFITHS

Min. 504. Theoretical Mineralogy (3) Selected topics in crystal chemistry and crystal physics applied to solid solution, polymorphism, crystal growth, and related phenomena; laboratory studies of identification techniques including X-ray diffraction. Prerequisite: Min. 31. Lecture 2 hours, practicum 3 hours.
PROFESSOR T. F. BATES

†**Min. 505. Mineralogy Seminar** (1-2) Reading, presentation, and discussion of literature dealing with various phases of theoretical mineralogy. Topics are selected to meet the interests of the majority of the students. Lecture 1 hour. PROFESSORS P. D. KRYNINE, E. F. OSBORN, T. F. BATES, J. C. GRIFFITHS

‡**Min. 507. Physicochemical Petrography** (2-3) Advanced work in the constitution and phase relations of inorganic crystals and liquids; special emphasis on silicate compounds and glasses. Prerequisite: Min. 483. Lecture 2 hours, practicum 3 hours.
PROFESSOR E. F. OSBORN

‡**Min. 508. Physicochemical Petrology** (2-3) Application of the principles of physicochemical petrography to the origin of igneous and metamorphic rocks. Prerequisite: Min. 507. Lecture 2 hours, practicum 3 hours.
PROFESSOR E. F. OSBORN

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*Credits to be arranged, 3-9 per semester.
†Credits to be arranged, 1 per semester.
‡Credits to be arranged, 1-3 per semester.

§Min. 510. Metamorphism (2-6) A detailed review of chemical mineralogical and structural changes that take place during metamorphism. Prerequisite: Min. 483. Lecture 1 to 4 hours, practicum 3 to 6 hours.
PROFESSORS P. D. KRYNINE, E. F. OSBORN, T. F. BATES, J. C. GRIFFITHS

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Min. 460. Physical Mineralogy (3) Fee $4. PROFESSOR T. F. BATES
Min. 461. Descriptive Mineralogy (3) Fee $2. PROFESSOR T. F. BATES
Min. 483. Petrography (4) Fee $5. PROFESSOR J. C. GRIFFITHS
Min. 485. Sedimentation (3) Fee $5. PROFESSOR P. D. KRYNINE
Min. 486. Petrography of Oil Reservoirs (1) PROFESSOR P. D. KRYNINE
Min. 487. Petrography of Oil Reservoirs Laboratory (2) Fee $5.
PROFESSORS P. D. KRYNINE, J. C. GRIFFITHS

MINING

MR. ALFRED E. FLOWERS, B.S.
Acting Chief of the Division

Mng. 500. Mining Seminar (2) Conferences, reading, and reports. Scientific management; public relations; technological developments. Required of all graduate students in mining engineering. Lecture 2 hours.

Mng. 501. Mine Engineering (3) Mine mechanization problems. The selection of the most suitable equipment for various conditions. Prerequisite: Mng. 488. Lecture 3 hours.

Mng. 504. Mining Research (3-10) Research work on specific problems in physics of mining and mine mechanization. Prerequisite: Mng. 481. Practicum 9 to 30 hours. Fee $2 per credit.

Mng. 506. Mine and Mine Plant Design (3-10) The layout, design, and selection of equipment for specific mining and mine plant projects. Prerequisite: Mng. 499. Practicum 9 to 30 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Mng. 400. Mine Safety Engineering (1) MR. A. E. FLOWERS
Mng. 481. Physics of Mining (4) Fee $2.50.
Mng. 483. Mineral Property Valuation (2) MR. A. E. FLOWERS
Mng. 488. Advanced Mine Mechanization (2)
Mng. 499. Advanced Mining Design (2) Fee $1.

MUSIC

PROFESSOR HUMMEL FISHBURN, M.A.
Head of the Department

Music 511-514. Advanced Piano (3 per course) Artistic performance of piano literature of all periods; program building stressed according to individual

§Credits to be arranged, 2-4 per semester.

taste and ability; designed to help students prepare for the demands of successful public performance; technique, interpretation, memory, and the qualities that make for musicianship and poise at the piano. Fee $25 per course. Professor Guy Woods

Music 558-561. Free Composition (3 per course) An opportunity for graduate students to do original work under supervision. Weekly conferences; analysis and discussion of the style and technique of standard and contemporary composers; experimental writing in various styles. Prerequisites: harmony 12 credits, piano 8 credits. Professor G. W. Henninger

Music 563. Free Arranging (3) Correct procedure in arranging for vocal and instrumental ensembles; practical exercises in the field of quartets, glee clubs, and choruses; small instrumental groups, band, and orchestra. Prerequisite: harmony 18 credits, including 3 of orchestration.
Professor Hummel Fishburn

Music 567. The Literature of the Orchestra (3) Outstanding orchestra works of great composers of that medium, from the appreciation and historic point of view; analysis of the form and styles of the suite, the symphony, the tone poem, and the overture; survey of instrumentation and orchestration from the early chamber group to the present symphony orchestra. Prerequisites: Music 6 and theoretical knowledge of the key instruments of the orchestra.
Professor Hummel Fishburn

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Music 407. Piano Repertoire (3) Professor Guy Woods

Music 408. Vocal Literature (3) Mrs. Elizabeth Reynolds

Music 429-432. Singers' Style and Interpretation (3 per course) Fee $25 per course. Professor Willa Taylor

Music 456. Elementary Counterpoint (3) Professor G. W. Henninger

Music 464. Musical Literature of the Romantic Period (3)
Professor Hummel Fishburn

Music 465. Musical Literature of the Modern Period (3) Fee $1.
Professor Hummel Fishburn

Music 466. Advanced Conducting (3) Professor Frank Gullo

MUSIC EDUCATION

Professor Hummel Fishburn, M.A.
Head of the Department

Music Ed. 500. Music Education Seminar (3-6) Problems of various phases of music education, both instrumental and vocal; research and literature dealing with these problems. Professor Hummel Fishburn and Staff

Music Ed. 571. Vocal Pedagogy (3) Practical ways of solving problems in teaching public school vocal music; physiological, acoustic, and psychological factors of singing; investigation of traditional methods of training singers; voice class pedagogy and procedures for conducting high school voice training classes. Prerequisites: Music Ed. 48 and teaching experience.
Professor Willa Taylor

Music Ed. 572. Instrumental Pedagogy (3) Problems involved in teaching the instruments of the band and orchestra; materials for individual and group instruction; a clinical survey of new materials. Prerequisite: Music Ed. 54, or practical experience. PROFESSOR HUMMEL FISHBURN

Music Ed. 573. The Materials of Appreciation (3) Designed to acquaint the teacher of music appreciation with recorded material available for appreciation classes; special emphasis on materials for courses in secondary schools, colleges, and for adult groups, as well as recordings that can be used by instrumental and vocal teachers in their work outside of appreciation classes. Prerequisites: Music 5, and teaching experience. MISS FRANCES ANDREWS

Music Ed. 574a,b. Present-Day Trends in Music Education (3-6) Present-day trends in music education in the elementary school with special emphasis upon: relationship of music to the entire school program; co-ordination of various types of musical activities; current materials and practices; practical and specific problems of teaching and organization of immediate importance to the personnel of the class. Prerequisites: Music Ed. 48 and teaching experience. MISS FRANCES ANDREWS

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Music Ed. 462. Pedagogy of Theory (3) PROFESSOR G. W. HENNINGER

Music Ed. 468. The Teaching of Piano (3) PROFESSOR GUY WOODS

Music Ed. 469. Band and Orchestra Technique (3) PROFESSOR FRANK GULLO

Music Ed. 470. Choral Technique (3) PROFESSOR WILLA TAYLOR

Music Ed. 475. Objectives and Problems in Elementary Music Education (3) PROFESSOR WILLA TAYLOR

NATURE EDUCATION

Consult PROFESSOR GEORGE J. FREE, M.A.

The following course may be taken for graduate credit under the restrictions in force:

Nat. Ed. 401. Nature Training for Camp Counselors (3) PROFESSOR G. J. FREE

PETROLEUM AND NATURAL GAS

PROFESSOR S. T. YUSTER, Ph.D.
Chief of the Division

Pet. E. 500a. Petroleum and Natural Gas Engineering Research (3-9 per semester) Fee $2 per credit.

Pet. E. 501. Energetics of Petroleum Engineering (3) Fundamental laws and systematic derivation of formulae with applications to production of petroleum and natural gas; energetics of phase equilibria; use of partial quantities in field problems; deviations from simple mixture laws; applications of material and energy balances. Prerequisite or concurrent: M.E. 104, Pet. E. 481. Lecture 3 hours.

Pet. E. 502a. Petroleum and Natural Gas Engineering Seminar (3-9) An intensive study of one or several phases of petroleum engineering.

Pet. E. 503. The Flow of Homogeneous Fluids Through Porous Media (3) The mathematical relations governing the flow of homogeneous liquids through porous media; rate of flow and pressure distribution according to various well spacing patterns; application to water flooding and gas repressuring. Prerequisites: Math. 431, Pet. E. 74. Lecture 3 hours.

Pet. E. 504. Water Flooding (3-6) Fundamental physical forces involved in water flooding, core data interpretation, well spacing, pattern layout, shooting, water treatment, pressure plant, methods of pumping, delayed drilling, selective plugging, use of gas in water flooding, production curtailment, and the economics of water flooding. (Course may be expanded to 6 hours credit with special laboratory problem.) Prerequisite: Chem. 40. Lecture 2 hours, practicum 3 hours.

Pet. E. 506. Advanced Petroleum Engineering (5) Flow of oil and gas mixtures in vertical pipes; application of the vibration theory to deep well pumping; corrosion of oil field equipment, cathodic protection; production chemistry; mechanical and chemical selective exclusion of liquids from wells; field treatment of crudes, emulsions, field refining of crudes, and salt water disposal. Prerequisites: Chem. 41, Pet. E. 74. Lecture 4 hours, practicum 3 hours. Fee $5.

Pet. E. 507. Condensate Fields (2) Retrograde condensation phenomenon of hydrocarbon mixtures at high pressure; literature on condensate fields; production methods and equipment design: casing heads, compressors, separators, stabilizers; safety measures. Prerequisite: Pet. E. 501. Lecture 2 hours.

Pet. E. 508. Colloidal Behavior of Industrial Clays, Muds, and Slimes (2) Principles of colloidal activity applied to the control of the properties of clay slips, drilling fluids, and similar suspensions; swelling of shales and bentonites; colloidal phenomena associated with the beneficiation and use of industrial minerals. (In co-operation with the Ceramics staff.) Prerequisite: Chem. 41. Lecture 2 hours. PROFESSOR E. C. HENRY

Pet. E. 509. Advanced Petroleum Engineering Design (2) A continuation of Pet. E. 84. Projects in the selection of engineering materials for casing programs, drilling rigs; production, treatment, stabilization, and transportation of crude oils. Prerequisite: Pet. E. 84. Lecture 1 hour, practicum 3 hours.

Pet. E. 510. Modern Methods of Hydrocarbon Analyses (3) Recently developed methods of analysis of hydrocarbon mixtures, principally infrared spectrum analysis, Raman spectrum analysis, magneto-optic analysis, mass spectrum analysis, etc. Prerequisite: Phys. 475. Lecture 2 hours, practicum 3 hours.

Pet. E. Lab. 508. Rotary Drilling Fluid Laboratory (1) Determination of size distribution of particles, electrodialysis, acid and base exchange capacity, ultimate pH, swelling of clays and its control, viscosity of muds and related properties, thixotropy, weighing materials. Prerequisite: Chem. 41. Concurrent: Pet. E. 508. Practicum 3 hours. Fee $5.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Pet. E. 481. Natural Gas and Gasoline Plants (4)

Pet. E. 491. Oil and Gas Reservoir Engineering (3) PROFESSOR S. J. PIRSON

Pet. E. 492. Petroleum Economics (3)

Pet. E. Lab. 481. Natural Gas Laboratory (1) Fee $5.

Pet. E. Lab. 490. Advanced Core Testing (3)

PHILOSOPHY

Consult PROFESSOR JOHN A. MOURANT, A.M., Ph.D.

Phil. 500a,b. Ethical Seminar (2-6) A critical study of some phase of ethical fact and theory.

Phil. 501a,b,c,d. Philosophy Seminar (2-12) Designed to meet the demand for advanced study in special fields of philosophical thought.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Phil. 402. Seventeenth and Eighteenth Century Philosophy (3)

Phil. 418. Recent and Contemporary Philosophy (3)

PHYSICAL EDUCATION

Consult PROFESSOR LLOYD M. JONES, M.A., Ph.D.

Phys. Ed. 500. Problem in Physical Education (3) Prerequisite: Phys. Ed. 455.

Phys. Ed. 510. Program for the Summer Camp (3) Prerequisites: Phys. Ed. 430 and experience as a camp counselor or director.

PROFESSOR F. M. COOMBS

Phys. Ed. 522. Organization and Administration of Physical Education in Colleges and Universities (3) Procedures and policies involved in the administration of physical education in institutions of higher learning; credits, schedules, excuses, records, reports, budgets, classification, tests, administration of plants and fields, and the relationships of physical education to the educational plan of the institution. Prerequisite: Phys. Ed. 491.

PROFESSOR G. N. THIEL

Phys. Ed. 523. Administration of College Athletics (3) Eligibility schedules, managerial systems, the relationships of athletics to the physical education program and to education in general; individual or committee reports on topics of special interest. Prerequisite: Phys. Ed. 491. PROFESSOR F. J. BEDENK

Phys. Ed. 526. Athletic Problems in Schools (3) Problems of body mechanics in executing the various skills in athletic sports; practical psychology in handling players and assistants; problems of the assignments of responsibility in certain sports; coaching methods; term report on some aspect of high school athletics required. Prerequisites: Phys. Ed. 460, 481.

PROFESSOR F. J. BEDENK

Phys. Ed. 528. Professional Education of Teachers of Health and Physical Education (3) Health and physical education surveys, publicity, sociability and personality tests, legislation, state certification, standards for facilities and equipment, in-service, follow-up, and teacher-community problems; student reports on various aspects of the work. Prerequisite: Phys. Ed. 491.

PROFESSOR L. M. JONES

Phys. Ed. 529. Supervision of Physical Education in Schools (3) Methods and policies of the school supervisor of physical education; detecting and remedying teaching errors, types of conferences, planning and presenting the program, evaluating results, improving teachers-in-service, supervision of the classroom teacher, and relationships with the administration. Prerequisites: Phys. Ed. 491, 452, 453. PROFESSOR L. M. JONES

Phys. Ed. 530. Research Techniques in Health and Physical Education (3) Selecting and defining possible problems in health and physical education; scientific methods as applied to this field; sources of data, methods of collecting and interpreting data; methods of writing and publishing reports of problems; periodic student reports demonstrating ability to apply the methods and techniques to a selected problem. Prerequisite: Phys. Ed. 455.
PROFESSOR J. D. LAWTHER

Phys. Ed. 531. Research in Health and Physical Education (3) Prerequisite: Phys. Ed. 530. PROFESSOR L. M. JONES

Phys. Ed. 532. Tests and Measurements in Physical Education (3) Critical study of the tests and measurements available in physical education; methods of constructing and evaluating new tests and measurements. Prerequisite: Phys. Ed. 490. PROFESSOR F. J. BEDENK

Phys. Ed. 533. Recreation Studies, Surveys, and Appraisals (3) Types, purposes, and methods of conducting recreation studies and surveys; procedures in the appraisal of community recreation. Prerequisite: Phys. Ed. 530. Lecture 3 hours.

Phys. Ed. 534. Studies in Curriculum Construction in Physical Education (3) An overview of principles and methods of curriculum and course of study building in physical education; the different psychological and educational points of view as related to curriculum construction, organizing a course of study committee, setting up objectives and guiding principles, making units of construction. Prerequisites: Phys. Ed. 452, 453, 454. PROFESSOR L. M. JONES

Phys. Ed. 535. Modern Foreign Systems of Physical Education (3) Comparative analysis of national and local programs and systems of physical education in foreign countries. Prerequisites: Phys. Ed. 534, 595.
PROFESSOR C. M. SPEIDEL

Phys. Ed. 536. Scientific Methods in Athletic Coaching (3) Unusual techniques in athletic coaching which are not commonly recognized and used; advanced skills and strategy in coaching major sports. Prerequisite: Phys. Ed. 460. PROFESSOR J. D. LAWTHER

Phys. Ed. 550. Seminar in Health and Physical Education (1-6) Open only to students preparing approved theses and dissertations.
PROFESSOR L. M. JONES AND STAFF

Phys. Ed. 555. Relationships of Physical Education to the Exact Sciences (3) Anatomy, physiology, chemistry, physics, biology, studied for the purpose of collecting and classifying scientific facts which form the foundations of certain policies, procedures, principles, programs, objectives, and standards of physical education. Prerequisite: Phys. Ed. 481. PROFESSOR MILDRED LUCEY

Phys. Ed. 560. Administrative Problems of Physical Education in Schools (3) Solutions to problems emerging from the administration of physical education in schools, such as credit for college entrance, relationships of physical education to health education, fitting physical education into the school's

schedule, the handling of excuses and absences, measuring and evaluating results, awards and budgets. Prerequisite: Phys. Ed. 491.
PROFESSOR L. M. JONES

Phys. Ed. 595. Philosophy of Health and Physical Education (3) The philosophical factors underlying past and future considerations of health and physical education; particular attention to the various crucial forces influential in changing one's philosophy of health and physical education. Prerequisites: Phys. Ed. 454, 491. PROFESSOR L. M. JONES

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Phys. Ed. 424. Modern Trends in Health Education, Physical Education, Recreation, and Athletics (3) PROFESSOR L. M. JONES

Phys. Ed. 429S. The Modern Dance in Education (3) MISS DOROTHY BRIANT

Phys. Ed. 430. Introduction to Organized Camping (3)
PROFESSOR F. M. COOMBS

UNIT A. SCOPE, SIGNIFICANCE, AND LEADERSHIP (1)

UNIT B. FACILITIES, EQUIPMENT, AND ORGANIZATION OF ACTIVITIES (1)

UNIT C. ADMINISTRATIVE PROCEDURES (1)

Phys. Ed. 431S. Coaching of Advanced Baseball (3) Fee $5.
PROFESSOR F. J. BEDENK

Phys. Ed. 432. Recreation in Industry (3) PROFESSOR F. M. COOMBS

Phys. Ed. 433. Analysis of Recreational Methods (3)
PROFESSOR F. M. COOMBS

Phys. Ed. 435. Organization and Administration of Outdoor Recreation (1 per unit) PROFESSOR F. M. COOMBS

UNIT A. ADMINISTRATIVE PROCEDURES AND POLICIES (1)

UNIT B. CONDUCT OF THE PROGRAM (1)

UNIT C. FACILITIES, EQUIPMENT, AND FINANCES (1)

Phys. Ed. 436S. Coaching of Advanced Football (3) Fee $5.
PROFESSOR R. A. HIGGINS

Phys. Ed. 437S. Coaching of Advanced Basketball (3) Fee $5.
PROFESSOR J. D. LAWTHER

Phys. Ed. 438S. Coaching of Advanced Track (3) PROFESSOR C. D. WERNER

Phys. Ed. 439S. Coaching of Advanced Soccer (3) MR. W. JEFFREY

Phys. Ed. 440S. Coaching of Advanced Gymnastics (3)
PROFESSOR E. WETTSTONE

Phys. Ed. 441S. Advanced Coaching of Athletics for Men (1-11)

UNIT A. BASKETBALL (1) Fee $2. PROFESSOR J. D. LAWTHER

UNIT B. FOOTBALL (1) Fee $2. PROFESSOR R. A. HIGGINS

UNIT C. TRACK AND FIELD (1) Fee $2. PROFESSOR C. D. WERNER

UNIT D. BASEBALL (1) Fee $2. PROFESSOR F. J. BEDENK

UNIT E. WRESTLING (1) Fee $2. PROFESSOR C. M. SPEIDEL

UNIT F. SOCCER (1) Fee $2. MR. W. JEFFREY

UNIT G. SWIMMING (1) Fee $2.

UNIT H. GYMNASTICS (1) Fee $2. PROFESSOR E. WETTSTONE

UNIT I. BOXING (1) Fee $2.

UNIT J. LACROSSE (1) Fee $2.
UNIT K. FENCING (1) Fee $2.

Phys. Ed. 449S. Advanced Teaching of Sports and Rhythmics (1-8)
UNIT A. SOCCER AND SPEEDBALL (1) Fee $2. PROFESSOR MILDRED LUCEY
UNIT B. BASKETBALL (1) Fee $2. PROFESSOR MILDRED LUCEY
UNIT C. FIELD HOCKEY (1) Fee $2. PROFESSOR MILDRED LUCEY
UNIT D. ARCHERY (1) Fee $2. PROFESSOR MARIE HAIDT
UNIT E. SWIMMING (1) Fee $2. MISS MARION WHALLON
UNIT F. RHYTHMICS FOR CHILDREN (1) Fee $2. MISS DOROTHY BRIANT
UNIT G. MODERN DANCE AND ACCOMPANIMENT (1) Fee $2. MISS DOROTHY BRIANT
UNIT H. EARLY AMERICAN COUNTRY DANCING AND SOCIAL DANCING (1) Fee $2. MISS DOROTHY BRIANT
UNIT I. TENNIS (1) Fee $2.
UNIT J. BADMINTON (1) Fee $2.
UNIT K. GOLF (1) Fee $2.

Phys. Ed. 452S, 452X. Analysis of Physical Education Activities for the Elementary School (3) Fee $3. PROFESSOR C. M. SPEIDEL

Phys. Ed. 453S, 453X. Analysis of Physical Education Activities for the High School (3) Fee $5. PROFESSOR E. C. BISCHOFF

Phys. Ed. 454. The Natural Program of Physical Education Activities, Applied (3) Fee $5. PROFESSOR E. C. BISCHOFF

Phys. Ed. 455. Scientific Method in Health and Physical Education (3) PROFESSOR L. M. JONES

Phys. Ed. 456. The Co-recreational Program in Schools (3) PROFESSOR F. M. COOMBS

Phys. Ed. 460. Methods and Principles of Athletic Coaching (3) PROFESSOR J. D. LAWTHER

Phys. Ed. 461, 461X. Programs of Community Recreation (1 per unit) PROFESSOR F. M. COOMBS
UNIT A. PROGRAMS OF THE RURAL COMMUNITY (1)
UNIT B. PROGRAMS OF THE URBAN COMMUNITY (1)
UNIT C. PROGRAMS OF THE LARGE MUNICIPALITIES (1)

Phys. Ed. 462. Recreation for the Handicapped (3) PROFESSOR C. M. SPEIDEL

Phys. Ed. 463. Recreation Law (3) PROFESSOR F. M. COOMBS

Phys. Ed. 465. Administration of Recreation (3) PROFESSOR F. M. COOMBS

Phys. Ed. 466S. Visual Instruction in Athletics (3) PROFESSOR R. M. CONGER

Phys. Ed. 471S. Health Education, Physical Education, Recreation, and Athletics for the School Administrator (3) PROFESSOR L. M. JONES
UNIT A. ATHLETICS IN THE SCHOOLS (1)
UNIT B. HEALTH EDUCATION IN THE SCHOOLS (1)
UNIT C. PHYSICAL EDUCATION AND RECREATION IN THE SCHOOLS (1)

Phys. Ed. 480. Advanced Anatomy and Physiology, Applied (3) Fee $5. PROFESSOR ELLEN KELLY

Phys. Ed. 481, 481X. Problems in Body Mechanics (3) PROFESSOR ELLEN KELLY

Phys. Ed. 482, 482X. Posture Education in the Schools (3) PROFESSOR ELLEN KELLY

Phys. Ed. 488S. The Administration of Physical Education and Athletics for Women (3) PROFESSOR MARIE HAIDT

Phys. Ed. 489. Intramural Athletics (3) PROFESSOR E. C. BISCHOFF

Phys. Ed. 490. Introductory Course in Tests and Measurements in Health and Physical Education (3) PROFESSOR F. J. BEDENK

Phys. Ed. 491. Organization and Administration of Health and Physical Education in Schools (3) PROFESSOR L. M. JONES

PHYSICS

PROFESSOR HAROLD K. SCHILLING, M.A., Ph.D.
Head of the Department

Phys. 501a,b,c,d,e. Physics Research (1-15 per semester) Original work to obtain material for a thesis. May be continued in successive semesters as Phys. 501b, 501c, etc. to a maximum of 45 credits. Fee $3 per credit.

Phys. 507. Theoretical Thermodynamics (3) A mathematical treatment of the principles of thermodynamics. Lecture 3 hours.

Phys. 509. Physics Seminar (1) Selected topics from current physical research critically examined and discussed. May be continued in successive semesters as Phys. 509a, 509b, 509c. Seminar.

Phys. 517. Kinetic Theory (3) The Maxwell-Boltzmann law, Brownian movements, specific heats, and other selected topics. Prerequisites: Phys. 411, Math. 431. Lecture 3 hours.

Phys. 521. Crystal Structure (3) The solution of the structure of crystals by X-ray methods. Lecture 3 hours. Available for major credit in either physics or chemistry.

Phys. 522. Advanced Crystal Analysis (3) A continuation of Phys. 521, including the application of crystal structure studies to physical, chemical, and metallurgical problems. Available for major credit in either physics or chemistry. Lecture 3 hours.

Phys. 530. Introduction to Theoretical Physics (3) The application of higher mathematics to problems in the various fields of physics. Prerequisites: Math. 431, Phys. 285. Lecture 3 hours.

Phys. 531. Theoretical Physics (3) A continuation of Phys. 530.

Phys. 533. Theory of Sound (3) Mathematical treatment of the theory of sound. Prerequisite: Phys. 530. Lecture 3 hours.

Phys. 551. Advanced Electron Theory (1-3) Properties of matter in terms of modern electronic theory. Prerequisite: Phys. 531. Lecture 1 to 3 hours.

Phys. 553. Nuclear Physics (3) Mathematical course in nuclear physics. Prerequisite: Phys. 562. Lecture 3 hours.

Phys. 557. Electricity and Magnetism (3) A treatment of the mathematical theory of electricity and magnetism. Prerequisite: Phys. 467. Lecture 3 hours.

Phys. 558. Electricity and Magnetism (3) Continuation of Phys. 557. Prerequisite: Phys. 557. Lecture 3 hours.

Phys. 559. Physical Optics (3) Advanced study of the physical properties of light. Prerequisite: Phys. 459. Lecture 3 hours.

Phys. 560. Advanced Physical Measurements (1-18) Offers opportunity for advanced work in the various fields of physics. Fee $3 per credit.

Phys. 561. De Broglie Waves and Quantum Mechanics (3) An introduction to the modern interpretation of atomic structure and radiation phenomena, based upon the de Broglie and Schroedinger wave theory. Prerequisite: Phys. 531. Lecture 3 hours.

Phys. 562. Wave Mechanics in Modern Physics (3) This continuation of Phys. 561 discusses the theory of atomic and simple molecular spectra, Zeeman and Stark effect, theories of metallic conductivity and thermionic emission, etc. Prerequisite: Phys. 561. Lecture 3 hours.

Phys. 571. Atomic Structure (3) Recent work in the field of atomic and subatomic physics. Lecture 3 hours.

Phys. 572. Spectroscopy (3) Atomic and molecular spectra, both emission and absorption, methods of excitation, radiation and ionization potentials, spectral series, fine structure, spectra of ionized and stripped atoms. Lecture 3 hours.

Phys. 575. Problems in Modern Physics (1-3) Theoretical studies in any field of modern physics with or without associated experimental work. Prerequisite: Phys. 455.

Phys. 577. Classical Mechanics (3) An advanced study of the principles and applications of classical mechanics. Prerequisite: Phys. 461. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Phys. 401. Electronics (3)
Phys. 403. Vacuum Tube Circuits (3)
Phys. 404. Measurements Employing Vacuum Tubes (2-4) Fee $3 per credit.
Phys. 411. Theoretical Mechanics (3)
Phys. 414. Measurements in Sound (1-3)
Phys. 433S. Intermediate Mechanics and Fluid Physics (3)
Phys. 435S. Intermediate Electricity and Magnetism (3)
Phys. 437S. Intermediate Heat, Sound, and Light (3)
Phys. 439S. Elementary Survey of Modern Physics (3)
Phys. 443. Intermediate Sound (3)
Phys. 451. Electronics and Ionics (3)
Phys. 452. Electronic Measurements (2-4) Fee $3 per credit.
Phys. 453. Electron Optics and Positive Ion Beams (3)
Phys. 455. Survey of Modern Physics (3)
Phys. 459. Intermediate Optics (3)
Phys. 460. Advanced Laboratory Optics (2-4) Fee $3 per credit.
Phys. 461. Theoretical Mechanics (3)
Phys. 463. Radioactivity and Nuclear Physics (3)
Phys. 467. Intermediate Electricity and Magnetism (3)
Phys. 468. Advanced Electrical Measurements (2) Fee $6.

Phys. 480. Glass Working and Laboratory Techniques (1-3) Fee $3 per credit.
Phys. 486. Astronomical Photography (3-6) Fee $3 per credit.
Phys. 490. Modern Stellar Theory (3-9) Fee $3 per credit.
Phys. 491S. Advanced Celestial Measurements (3-9) Fee $3 per credit.

POLITICAL SCIENCE

PROFESSOR JOHN H. FERGUSON, M.A., Ph.D.
Head of the Department

Pol. Sci. 500. Seminar in Political Science (3-6) Subject to be announced.
PROFESSORS H. F. ALDERFER, R. W. BREWSTER, J. H. FERGUSON, M. N. MCGEARY

Pol. Sci. 505. Seminar in Advanced American Government (3-6)
PROFESSORS R. W. BREWSTER, J. H. FERGUSON, M. N. MCGEARY

Pol. Sci. 510. Political and Administrative Problems in Pennsylvania (3) Lecture 3 hours. PROFESSOR M. N. MCGEARY

Pol. Sci. 515. Current International Problems (3) Current international relations and problems as they appear in the application of the Monroe Doctrine, the work of international organizations, and the programs of nationalism and internationalism. Lecture 3 hours.
PROFESSORS H. JANZEN, L. LEONARD

Pol. Sci. 520. Administrative Law (3-6) The law dealing with public officers and their procedure; the scope and limits of administrative powers; remedies against illegal government acts. Lecture 3 hours.
PROFESSORS R. W. BREWSTER, M. N. MCGEARY

Pol. Sci. 525. Public Opinion and Political Parties (3) An analysis of public opinion; the structure, methods, and regulation of organized groups and political parties. Lecture 3 hours. PROFESSOR H. F. ALDERFER

Pol. Sci. 535. Government Regulation (3) PROFESSOR J. H. FERGUSON

Pol. Sci. 540. National and State Government Planning (3)
PROFESSORS R. W. BREWSTER, J. H. FERGUSON, M. N. MCGEARY

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Pol. Sci. 413. Government and Foreign Policy of the Soviet Union (3)
PROFESSOR H. JANZEN

Pol. Sci. 414S. International Relations (3) PROFESSOR H. JANZEN

Pol. Sci. 415. International Organization (3) PROFESSOR L. LEONARD

Pol. Sci. 416. International Law (3) PROFESSOR H. JANZEN

Pol. Sci. 417. Municipal Government (3) PROFESSOR H. F. ALDERFER

Pol. Sci. 419. Public Administration (3) PROFESSOR M. N. MCGEARY

Pol. Sci. 420. Public Personnel (3) PROFESSOR M. N. MCGEARY

Pol. Sci. 421. Modern Political Theories (3) PROFESSOR J. T. LAW

Pol. Sci. 424. State Government in the United States (3)
PROFESSOR J. T. LAW

Pol. Sci. 425S. Pennsylvania Government (3) PROFESSOR M. N. MCGEARY

Pol. Sci. 428. Pennsylvania Local Government (3) PROFESSOR H. F. ALDERFER

Pol. Sci. 429. Pennsylvania Local Administration (3)
PROFESSOR H. F. ALDERFER

Pol. Sci. 431. Ancient and Medieval Political Theories (3)
PROFESSOR J. T. LAW

Pol. Sci. 432a,b,cS. Current Political Trends and Problems (3-9)

Pol. Sci. 433. Social Security and Labor Legislation and Administrative Problems (3) PROFESSOR J. H. FERGUSON

Pol. Sci. 435. Government Housing, Planning, and Public Works (3)
PROFESSOR R. W. BREWSTER

Pol. Sci. 436. Diplomacy and the Conduct of Foreign Relations (3)
PROFESSOR L. LEONARD

Pol. Sci. 442a,b,c. American Foreign Policy (1-3)

Pol. Sci. 444. Government Regulation (3) PROFESSOR J. H. FERGUSON

Pol. Sci. 445. Administrative Law (3) PROFESSOR R. W. BREWSTER

POULTRY HUSBANDRY

PROFESSOR ERNEST W. CALLENBACH, M.S.
Head of the Department

P.H. 502. Advanced Poultry Nutrition (2-4) Prerequisite: P.H. 3. Fee $1 per credit. PROFESSOR R. R. MURPHY

P.H. 503. Advanced Poultry Farm Management (2-4) Prerequisite: P.H. 8. Fee $1 per credit. PROFESSOR E. W. CALLENBACH

P.H. 504. Advanced Poultry Marketing (2-4) Prerequisites: P.H. 1, 7; Agr. Ec. 2 or 2 additional credits in poultry husbandry. Fee $1 per credit.
PROFESSOR P. H. MARGOLF

P.H. 505. Research in Poultry Husbandry (3-10) Prerequisite: 9 credits in poultry husbandry. Fee $2 per credit. PROFESSOR E. W. CALLENBACH

P.H. 506. Seminar in Poultry Husbandry (1-6)
PROFESSOR E. W. CALLENBACH AND STAFF

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

P.H. 412. Poultry Breeding (3) Fee $3. PROFESSOR A. J. G. MAW

PSYCHOLOGY

PROFESSOR B. V. MOORE, M.A., Ph.D.
Head of the Department

Psy. 500. Seminar in Psychology (1-4) Prerequisite: 9 credits in psychology.

Psy. 501. Advanced Psychology (2-4) A comprehensive study of general psychology. Prerequisite: 9 credits in psychology.

Psy. 502. Advanced Educational Psychology (2-4) Psychological theories and principles underlying educational theories and practices. Prerequisites: Psy. 14 or 441; Ed. 31 or teaching experience. PROFESSOR E. B. VANORMER

Psy. 503. Physiological Psychology (2-4) Correlations between the structure and function of the nervous system and the phenomena of human conscious-

ness; important laws and theories in the fields of sensation, attention, association, and affection. Prerequisite: 9 credits in psychology.
PROFESSOR J. E. DECAMP

Psy. 504. Comparative Psychology (2-4) Mind from the standpoint of growth and development; biological implications; a comparison of simple and complex animal forms with that of man; growth of the human mind paralleling physical growth. Prerequisite: 9 credits in psychology.
PROFESSOR J. E. DECAMP

Psy. 505. Research Problems in Psychology (1-15) Prerequisite: 12 credits in psychology.

Psy. 506. Clinical Psychology (1-6) Procedures used in the Psychology Clinic. Limited to students enrolled in Psy. 507. Prerequisites: Ed. 70 or Psy. 471; Psy. 476 or 477. PROFESSOR W. U. SNYDER

Psy. 507. Clinical Practicum (1-15) Practice in the administration and interpretation of clinical tests and proceedings. All available types of cases will be considered. Designed to meet the requirements for certification as school psychologists. Prerequisites: Ed. 70 or Psy. 471; Psy. 476 or 477. Fee $1 per credit. PROFESSORS R. G. BERNREUTER, W. U. SNYDER

Psy. 508. Procedures in Guidance and Personnel Administration (2-6) Analysis of the more technical problems of guidance counseling and personnel administration, and a critical evaluation of various techniques and devices available for meeting these problems. These methods and procedures will be organized into programs for specific purposes in particular situations. Prerequisites: Psy. 14, Ed. 453. Fee $1. PROFESSOR B. V. MOORE

Psy. 509. Techniques of Counseling (2) Theory and methodology of various standard techniques of counseling and psychotherapy, with stress laid on the applicability of each. Prerequisites: Psy. 437, 471, and 482 or 3 credits of 507. Lecture 2 hours. Fee $1 per credit. PROFESSOR W. U. SNYDER

Psy. 510. History of Psychology (2-4) The great systems, experiments, and personalities in the development of modern psychology, particularly since Fechner's time. Prerequisite: 9 credits in psychology.

Psy. 511. Contemporary American Psychology (2) Current systems or schools of psychology with a comparative study and critical analysis of each. Each point of view as presented by the recognized leaders will be studied. Each student will be expected to organize his own way of thinking in psychology and defend his point of view. Prerequisite: Psy. 501. PROFESSOR B. V. MOORE

Psy. 512. Advanced Abnormal Psychology (2) Various abnormal phenomena of mental behavior, and a critical analysis of the theories regarding these. Prerequisite: Psy. 412. PROFESSOR J. E. DECAMP

Psy. 513. Educational Psychology: Differential (2) The nature of individual differences in abilities, achievement, attitudes, interests, and various other emotional and social traits of personality; causes of these differences; and psychological implications of the methods used by schools in adjusting to individual differences. Prerequisites: Psy. 14 or 414, and 6 graduate credits in psychology. Lecture 2 hours. PROFESSOR E. B. VANORMER

Psy. 514. Educational Psychology: Learning (2) Experimentally determined facts about the learning process; main theories of learning suggested in explanation of the facts; educational implications of each theory; attempted synthesis and application of learning principles; and the special principles

derived from studies of memory and retention, transfer of training, and motivation. Prerequisites: Psy. 14 or 414, and 6 graduate credits in psychology. Lecture 2 hours. PROFESSOR E. B. VANORMER

Psy. 516. Clinical Techniques in Marital Counseling (2-3) Psychological principles and techniques in premarital and marital counseling, especially in respect to personal adjustment and the development of sexual and emotional maturity in marriage; methods of attacking and solving marriage problems emphasized. Prerequisites: Psy. 419 or 437. Lecture 2 or 3 hours. Fee $1. PROFESSOR C. R. ADAMS

Psy. 519. Practicum in Counseling (3) Practical experience in counseling for the advanced student, together with advanced theoretical considerations. Prerequisites: Psy. 507 or 509. Lecture 2 hours, practicum 3 hours. PROFESSOR W. U. SNYDER

Psy. 521. Research Problems in Industrial Psychology (2-6) Work on actual industrial personnel problems in laboratory and industrial plants; treatment of problems in monotony, fatigue, psychological selection, and training procedures, etc., in industry as opportunity affords and as indicated by interests of the student. Prerequisite: Psy. 21 or 421, and 431. PROFESSOR K. R. SMITH

Psy. 522. Advanced Psychological Marketing Research Techniques (3-6) Readings, practicum, and class discussion of technical aspects of sampling; construction, tabulation, and interpretation of questionnaires designed to test consumer reaction to products, advertising, and company policies from a psychological standpoint; special attention to analysis of motivation in consumer behavior. Prerequisites: 15 credits in psychology, including Psy. 15, 21, 422. Lecture 2 to 4 hours, practicum 1 to 2 hours. PROFESSOR L. P. GUEST

Psy. 599. Thesis (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Psy. 400. Honors Course in Psychology (2-6)

Psy. 407. Intermediate Experimental Psychology (3) Fee $2. PROFESSOR W. M. LEPLEY

Psy. 409. Bio-Psychology (3) Fee $5. PROFESSOR C. R. CARPENTER

Psy. 411, 411X. Psychology of the Preschool Child (3) Fee $1. PROFESSOR E. B. VANORMER

Psy. 412, 412X. Abnormal Psychology (3) PROFESSOR J. E. DECAMP

Psy. 414, 414X. Intermediate Educational Psychology (2-3) Fee $1. PROFESSOR E. B. VANORMER

Psy. 415, 415X. Intermediate Statistics in Psychology and Education (1-3)

Psy. 417. Social Psychology (2-3) Fee $2. PROFESSOR C. R. CARPENTER

Psy. 418. Measurement of Personality (3) Fee $1.50.

Psy. 419. Guidance and Education in Sexual and Marital Adjustment (3) Fee $1. PROFESSOR C. R. ADAMS

Psy. 420. Applied Social Psychology (3) Fee $3.

Psy. 421. Advanced Applied Psychology (3) Fee $1.

Psy. 422. Psychological Methods of Measuring the Reactions of the Public (3) Fee $1.50. PROFESSOR L. P. GUEST

Psy. 423. Test Construction and Standardization (2-3)
PROFESSOR C. R. ADAMS

Psy. 424. Psychological Techniques in Public Personnel Administration (3) Fee $1.
PROFESSOR C. R. ADAMS

Psy. 425, 425X. Psychology of the Elementary School Child (2-3) Fee $1.
PROFESSOR E. B. VANORMER

Psy. 426, 426X. Adolescence (2-3) Fee $1. PROFESSOR E. B. VANORMER

Psy. 427. Psychological Principles in Advertising (3) Fee $1.50.
PROFESSOR L. P. GUEST

Psy. 431. Industrial Psychology (3) Fee $1. PROFESSOR K. R. SMITH

Psy. 437, 437X. Mental Hygiene (2-4) Fee $1.

Psy. 440. Psychology Projects (1-6)

Psy. 471, 471X. Measurement of Intelligence (2) Fee $2.50.
PROFESSOR W. U. SNYDER

Psy. 472. Special Ability Testing (3) Fee $2.

Psy. 476. Psychometric Technique: Binet (2) Fee $3.

Psy. 477. Psychometric Technique: Nonverbal (2) Fee $2.50.

Psy. 478. Psychometric Techniques: Advanced (2) Fee $1.50.

Psy. 479. Psychometric Techniques: Projective (3)

Psy. 481. Advanced Projective Techniques (3)

Psy. 482. Introduction to Clinical Psychology (3)

PUBLIC UTILITIES

PROFESSOR ERIC A. WALKER, M.S., Sc.D.
Head of the Department of Electrical Engineering

Pub. Util. 521. Public Utilities (3) Problems of current interest in the public utility field, principally those utilities involving the use of the principles of electrical engineering. One or two conferences per week.
PROFESSOR L. A. DOGGETT

In addition to this course the following may be taken for graduate credit under the restrictions in force:

Pub. Util. 421. Electric Utilities (3) PROFESSOR L. A. DOGGETT

*RURAL SOCIOLOGY

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.
Head of the Department of Agricultural Economics and Rural Sociology

Rur. Soc. 551. Rural Sociology Seminar (1-6) Prerequisite: 6 credits in rural sociology, sociology, or psychology. Lecture 3 hours.

Rur. Soc. 552. The Structure of Rural Society (3) Systematic review of research dealing with the structure of rural society; the purpose, methodology, and contribution of each study treated. Prerequisites: Rur. Soc. 11, Soc. 1. Recitation 3 hours.

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*Credit in rural sociology will also be given for Agr. Ec. 505 and 525.

Rur. Soc. 553. Rural Social Processes (3) Continuation of Rur. Soc. 552. The functioning of rural society; research dealing with the subject reviewed and evaluated. Prerequisites: Rur. Soc. 11, 552. Recitation 3 hours.

Rur. Soc. 554. Advanced Rural Social Welfare (3) Analysis of welfare techniques and their application to rural situations. Prerequisites: Rur. Soc. 11; Psy. 2 or Rur. Soc. 459. Recitation 3 hours. PROFESSOR W. G. MATHER

Rur. Soc. 555. The Rural Church (3) The rural church as a social institution; its relation to the community; the church in "problem" areas; effects of population trends on the program of the rural church; the use of case studies and surveys. Prerequisite: 6 credits in rural sociology, sociology, or psychology. Recitation 3 hours. PROFESSOR W. G. MATHER

Rur. Soc. 556. Thesis in Rural Sociology (6) A preparation of the required thesis for the degree of Master of Science in rural sociology while in residence at The Pennsylvania State College.

Rur. Soc. 559. Advanced Rural Social Psychology (3) The application of social psychological principles to the treatment of rural problems. Prerequisites: Rur. Soc. 11, Psy. 2. Recitation 3 hours. PROFESSOR M. E. JOHN

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Rur. Soc. 452. Rural Organization (3) PROFESSOR M. E. JOHN

Rur. Soc. 454. Rural Social Welfare (3) PROFESSOR W. G. MATHER

Rur. Soc. 456. Rural Standards of Living (3) PROFESSOR W. G. MATHER

Rur. Soc. 459. Rural Social Psychology (3) PROFESSOR M. E. JOHN

SOCIOLOGY

Consult PROFESSOR SETH W. RUSSELL, M.A., Ph.D.

Soc. 503. Problems of Social Psychology (3) Investigation of the theories, methods, and empirical data of social psychology, with particular reference to such problems as the relations between personality and culture, social and personal disorganization, the development of role behavior, and the conception of the self. PROFESSOR W. COUTU

Soc. 510. Field Work in Sociology (1-3) Advanced research projects to be carried out in the field under the supervision of the department and recognized social agencies.

Soc. 512. Modern Criminology (3)

Soc. 513. Advanced Sociological Research Methods and Techniques (3) Special problems in scientific method and research technique; designed to prepare the student for social inquiry on a professional level; embraces both quantitative and nonquantitative type of work. Prerequisites: Soc. 413 and 3 credits of statistics.

Soc. 515. Structure and Functions of the Community (3)
PROFESSOR S. W. RUSSELL

Soc. 516. Sociological Theory (3)

Soc. 519. Seminar in Race Relations (3-6) The status and problems of minority peoples in selected areas of the world; analysis of the material, social, and sociopsychic aspects of race relations presented in lectures, reports, and papers. Lecture 3 hours.

Soc. 523. Advanced Research in Population (3) Supervised original research on some aspect of demographic phenomena and vital statistics; a genuine contribution to knowledge is expected of the student.

Soc. 525. Seminar in Sociology (3-9) An advanced seminar in sociological theory, involving intensive study of the works of several eminent authors. The list of social theorists dealt with varies from one semester to another, but only those are selected who have made fundamental contributions to the analysis of social structure, social interaction, and social change.

Soc. 530. Research on Marriage and the Family (3) Training in methods and techniques of research in the field of family relations. Under the guidance of the instructor experimental, statistical, and comparative studies are carried out, individually or co-operatively. Prerequisites: graduate standing and 3 hours' previous work in this field. Lecture 3 hours.

Soc. 534. Problems in Social Control (3) An advanced seminar dealing with the cohesive factors in societies and groups. Differentiates the forms and the instrumentalities of social control, traces their development in different periods, and attempts a systematic explanation of them, utilizing experimental and quantitative approaches where applicable.

Soc. 540. Anthropological Theory (3) A seminar in which major anthropological concepts and theories are critically studied. Anthropological theories are tested by the use of empirical ethnological material.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Soc. 403a. Personality and Social Adjustment (3) — PROFESSOR W. COUTU

Soc. 403b. Personality and Social Adjustment (3) — PROFESSOR W. COUTU

Soc. 405S. Social Problems (3)

Soc. 409. Juvenile Delinquency (3) — PROFESSOR E. ABRAMSON

Soc. 413. Methods and Techniques of Social Research (3) — PROFESSOR JESSIE BERNARD

Soc. 415a. Community Institutions (3) — PROFESSOR JESSIE BERNARD

Soc. 415b. Community Institutions (3) — PROFESSOR JESSIE BERNARD

Soc. 419. Minority Peoples (3)

Soc. 421. Field Work in Sociology (3-9) — MR. C. ANDERSON

Soc. 423. Population Research (3)

Soc. 424. Social Change (3)

Soc. 425. Contemporary Sociological Theory (3) — PROFESSOR L. L. BERNARD

Soc. 426. Introduction to Public Welfare (3)

Soc. 427S. Family Case Work (6)

Soc. 430. Marriage and the Family (3) — PROFESSOR JESSIE BERNARD

Soc. 440. Primitive Society (3)

SPANISH

PROFESSOR ROBERT J. CLEMENTS, M.A., Ph.D.
Head of the Department of Romance Languages

Sp. 551. Romance Philology (3) Historical development of the Romance languages. Recitation 3 hours. — PROFESSOR H. H. ARNOLD

Sp. 552. Old Spanish Readings (3) Aims at familiarizing the student with Old Spanish texts. Prerequisite: Sp. 551. Recitation 3 hours.
PROFESSOR P. R. DAUGHERTY

Sp. 561. Spanish Drama Previous to Lope de Vega (3) Origin and early development of the Spanish national drama. Representative plays of different types will be read and discussed. Lectures and reports. Recitation 3 hours.
PROFESSOR H. H. ARNOLD

Sp. 562. Spanish Drama Previous to Lope de Vega (3) Continuation of Sp. 561. Recitation 3 hours. PROFESSOR H. H. ARNOLD

Sp. 565. Lope de Vega (3) PROFESSOR H. H. ARNOLD

Sp. 566. Lope de Vega's Followers (3) PROFESSOR H. H. ARNOLD

Sp. 567. Cervantes and His Works (3) PROFESSOR P. R. DAUGHERTY

Sp. 568. Cervantes and His Works (3) PROFESSOR P. R. DAUGHERTY

Sp. 571. Seminar in Spanish Literature (3) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor. Recitation 3 hours.
PROFESSOR H. H. ARNOLD

Sp. 572. Seminar in Spanish Literature (3) Continuation of Sp. 571. Recitation 3 hours. PROFESSOR H. H. ARNOLD

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Sp. 401. The Golden Age (3) PROFESSOR H. H. ARNOLD

Sp. 402. Drama of the Golden Age (3) PROFESSOR H. H. ARNOLD

Sp. 403. Don Quixote (3) PROFESSOR H. H. ARNOLD

Sp. 404. Old Spanish Language and Literature (3) PROFESSOR H. H. ARNOLD

Sp. 405. Spanish Drama of the Nineteenth Century (3)
PROFESSOR P. R. DAUGHERTY

Sp. 406. Contemporary Spanish Drama (3) PROFESSOR P. R. DAUGHERTY

Sp. 407. The Spanish Novel of the Nineteenth Century (3)
PROFESSOR P. R. DAUGHERTY

Sp. 408. The Contemporary Spanish Novel (3) PROFESSOR P. R. DAUGHERTY

Sp. 409. Introduction to Latin-American Literature (3)
PROFESSOR H. H. ARNOLD

Sp. 410. Introduction to Latin-American Literature (3)
PROFESSOR H. H. ARNOLD

Sp. 411. Mexico: Its Language and Literature (3)
PROFESSOR P. R. DAUGHERTY

Sp. 412. Argentina: Its Language and Literature (3)
PROFESSOR P. R. DAUGHERTY

Sp. 415, 415X. Modern Spanish Lyric Poetry (3) PROFESSOR H. H. ARNOLD

Sp. 417, 417X. Spanish Literature in the Romantic Period (3)
PROFESSOR H. H. ARNOLD

Sp. 490. Advanced Composition (3) PROFESSOR P. R. DAUGHERTY

SPEECH

PROFESSOR JOSEPH F. O'BRIEN, M.S.
Chairman, Administrative Committee

Speech 500. Seminar in American Oratory (2-4) The history of American oratory, with the application of critical standards to the work of specific orators. Prerequisite: 6 credits in speech, including Speech 200.
PROFESSOR J. F. O'BRIEN

Speech 510. Seminar in Methods of Teaching Speech (2-4) Problems in curriculum construction, media, and methods as met by the high school and college teacher of speech. Consideration of speech as a unit of English, as a distinct discipline, and as an extracurricular activity. Prerequisite: 6 credits in speech, including Speech 200. PROFESSOR J. F. O'BRIEN

Speech 520. Seminar in Speech Science (2-4) A seminar in the physical and physiological bases of speech and voice; introduction to the laboratory techniques used in speech research. Prerequisite: 9 credits in speech, speech education, or psychology.

Speech 525. Seminar in Clinical Speech Pathology (2-4) A physiological, neurological, and psychological view of the speech process together with a critical study of modern theories and practices in clinical speech pathology. Prerequisites: Speech 490, 491; or Speech Ed. 438.

Speech 540. Seminar in the Problems of Radio (3) Advanced study and research in special problems in radio speech, radio production, and radio organization. Prerequisite: 6 hours of speech including Speech 200, 300, 425 or 435. Lecture 1 hour, recitation 2 hours.

Speech 550. Seminar in Oral Persuasion (2-4) The theory of persuasion; persuasive devices and techniques; criticism and appreciation of men of political, economic, and social movements, and of contemporary public address in the light of modern theories of persuasion. Prerequisite: 6 credits in speech, including Speech 200. PROFESSOR C. H. SCHUG

Speech 560. Public Address (2-4) Intended to aid the student in becoming proficient in public platform address; emphasis on practical application of principles of persuasion, especially through composition, discussion, criticism, and delivery of the speech outline and manuscript. Prerequisite: 9 credits in speech, including Speech 200 and 550. PROFESSOR C. H. SCHUG

Speech 575. Research Problems in Speech (1-12) Advanced research on an individual basis in oratorical criticism, discussion techniques, persuasion, pedagogy, phonetics, speech science, and speech pathology. Prerequisite: 12 credits in speech or in speech education.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Speech 400. Teaching of Speech (3) PROFESSOR J. F. O'BRIEN

Speech 405a,b,cS. Practical Problems in Public and Private Speech (1-3)

Speech 410. English Phonetics and Pronunciation (3) Fee $1.
PROFESSOR J. F. O'BRIEN

Speech 411a,b,cS. Speech Science and Speech Arts (1-3)

Speech 412. Advanced Speech Arts (3) PROFESSOR J. F. O'BRIEN

Speech 425. Advanced Principles of Radio Speech (3)

Speech 431. Anatomy and Physiology of the Ear and Vocal Mechanisms (3)

Speech 435. Radio Organization (3)

Speech 450. Discussion Techniques (3) PROFESSOR J. F. O'BRIEN

Speech 490. Speech Disorders and Their Treatment (3)
PROFESSOR E. T. MCDONALD

Speech 491. Clinical Speech Practicum (1-3) PROFESSOR E. T. MCDONALD

SPEECH EDUCATION

Consult PROFESSOR EUGENE T. MCDONALD, M.Ed., D.Ed.

Speech Ed. 537. Advanced Speech Correction (1-6) The clinical speech procedures of examination, diagnosis, and treatment. Prerequisite: Speech Ed. 437 or Speech 491. Lecture and practicum hours 1 to 6. Fee $1 per credit.
PROFESSOR E. T. MCDONALD

Speech Ed. 540. Articulation Disabilities (3) A detailed examination of speech-sound production disorders in children and adults; methods of examination, diagnosis, and treatment. Prerequisite: Speech 490 or Speech Ed. 436.

Speech Ed. 541. The Voice and Its Disorders (3) The physical, physiological, and psychological bases of voice production and the causes, nature, and symptoms of its disorders; current clinical methods in voice improvement demonstrated and discussed. Prerequisite: Speech Ed. 436 or Speech 490. Lecture 3 hours.

Speech Ed. 542. Stuttering and Allied Disorders (3) A detailed consideration of modern theories of the causes of disorders of rhythm; methods of examination, diagnosis, and treatment. Prerequisite: Speech 490 or Speech Ed. 436. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Speech Ed. 430. Problems of the Child with a Hearing Loss (3) Fee $1.
PROFESSOR E. T. MCDONALD

Speech Ed. 432. Methods of Teaching Speech (Lip) Reading (3)
PROFESSOR MARGARET RAABE

Speech Ed. 433. Auricular Training (2) PROFESSOR MARGARET RAABE

Speech Ed. 434. Audiometry (2) PROFESSOR E. T. MCDONALD

Speech Ed. 435. Clinical Practice with the Deaf and Hard-of-Hearing (3)

Speech Ed. 436. Speech Disabilities (3) PROFESSOR E. T. MCDONALD

Speech Ed. 437. Speech Correction (1-3) Fee $1.
PROFESSOR E. T. MCDONALD

Speech Ed. 439a, 439aX. Methods in Speech Education (3)
PROFESSOR MARGARET RAABE

Speech Ed. 440, 440X. Speech Education and Reeducation in the Elementary School (2-3) PROFESSOR MARGARET RAABE

ZOOLOGY

PROFESSOR EDWARD H. DUSHAM, M.S., Ph.D.
Head of the Department of Zoology and Entomology

Zool. 508. Advanced Parasitology (3) Advanced work on the structure, life cycle, and control of parasites. Prerequisites: Ent. 2, Zool. 432. Practicum 9 hours. Fee $5. PROFESSOR C. C. ZELIFF

Zool. 509. Techniques in Wildlife Management (3) The preparation of study mounts of game birds and mammals, methods of making a census, mapping management areas, method of collecting data, and determining food habits from examinations of stomach contents. Prerequisite: Zool. 546. Lecture 1 hour, practicum 6 hours. Fee $3. PROFESSOR P. F. ENGLISH

Zool. 512. Seminar (1) The review of current zoological literature. Required of graduate students majoring in zoology and entomology. Prerequisite: 12 credits in zoology or entomology. One conference per week.
PROFESSOR E. H. DUSHAM AND STAFF

Zool. 513. Research (1-15 per semester) The prosecution of an assigned problem under the guidance of an instructor. Prerequisite: Zool. 410, 432, 437, 440 or 546. PROFESSOR E. H. DUSHAM AND STAFF

Zool. 546. The Theory of Game Management (4) Fundamental principles underlying the management of wild game birds and mammals; the co-ordination of such management with the various land uses; the planning of preserves and other land areas. Prerequisites: Zool. 408, 420. Lecture 3 hours, practicum 3 hours. Fee $4. PROFESSOR P. F. ENGLISH

Zool. 551. Fisheries Management (3) The basic principles underlying the management of inland waters for fish production. Prerequisite: Zool. 450. Lecture 2 hours, practicum 3 hours. Fee $5. PROFESSOR E. A. LACHNER

Zool. 580S. General Zoology (3) Lectures, recitations, and laboratory work covering the more important principles in general zoology. For graduate students in education electing a major in biology or zoology. Fee $3.
PROFESSOR C. C. ZELIFF

Zool. 581. Advanced Invertebrate Zoology (3) The morphology, physiology, taxonomy, and life histories of invertebrate animals. Prerequisite: Zool. 580S. Fee $3. PROFESSOR C. C. ZELIFF

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Zool. 408. Mammology (4) Fee $3. PROFESSOR P. F. ENGLISH

Zool. 410. General Limnology (3) Fee $3. PROFESSOR E. A. LACHNER

Zool. 414. Herpetology (3) Fee $3. PROFESSOR E. A. LACHNER

Zool. 415. The Literature of Vertebrate Zoology (1)
PROFESSOR E. A. LACHNER

Zool. 416. The Methods of Research in Zoology (2)
PROFESSOR E. A. LACHNER

Zool. 420. Game Birds (3) Fee $3. PROFESSOR P. F. ENGLISH

Zool. 432. Human Parasitology (3) Fee $4.50. PROFESSOR C. C. ZELIFF

Zool. 436. Protozoology (3) Fee $5. PROFESSOR C. C. ZELIFF

Zool. 437. Histology (4) Fee $5. PROFESSOR G. B. NEWMAN

Zool. 440. Embryology (4) Fee $5. PROFESSOR G. B. NEWMAN
Zool. 443. Zoological Problems (3) PROFESSOR E. H. DUSHAM AND STAFF
Zool. 444. Zoological Problems (3) PROFESSOR E. H. DUSHAM AND STAFF
Zool. 445S. The Identification of Insects (3) Fee $2.
Zool. 447. Aquiculture (2) Fee $4. PROFESSOR E. A. LACHNER
Zool. 448. Ornithology (3) Fee $3. PROFESSOR M. WOOD
Zool. 450. Ichthyology (4) Fee $5. PROFESSOR E. A. LACHNER

The Pennsylvania State College Bulletin



ANNOUNCEMENT OF THE GRADUATE SCHOOL

1949
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THE PENNSYLVANIA STATE COLLEGE BULLETIN

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STATE COLLEGE, PENNSYLVANIA

The Pennsylvania State College Bulletin

ANNOUNCEMENT OF
THE GRADUATE SCHOOL



1949-50

State College, Pennsylvania

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COLLEGE CALENDAR

1949-1950

(As Applicable to the Graduate School)

1949

Second Semester 1948-1949

Feb. 4-5, Fri.-Sat.	Second Semester Registration
Feb. 7, Mon.	Second Semester Classes Begin 8 a.m.
Apr. 14, Thurs.	Spring Recess Begins 11:50 a.m.
Apr. 20, Wed.	Spring Recess Ends 8 a.m.
May 30, Mon.	Memorial Day Recess
June 1, Wed.	Second Semester Ends 5 p.m.
June 6, Mon.	Second Semester Graduation Exercises

Summer Program 1949

June 7, Tues.	Inter-Session Begins
June 24, Fri.	Inter-Session Ends 5:50 p.m.
June 27, Mon.	Registration for First Six-Weeks Session
June 28, Tues.	Summer Session Classes Begin 8 a.m.
July 4, Mon.	Independence Day Recess
Aug. 6, Sat.	End of First Six-Weeks Term 12:20 p.m.
Aug. 8, Mon.	Registration for Second Six-Weeks Term
Aug. 26, Fri.	Three-Weeks Post-Session Ends 5:50 p.m.
Sept. 5, Mon.	Labor Day Recess
Sept. 17, Sat.	Summer Program Ends 12:20 p.m.

First Semester 1949-1950

Sept. 26-27, Mon.-Tues.	First Semester Registration
Sept. 28, Wed.	First Semester Classes Begin 8 a.m.
Nov. 23, Wed.	Thanksgiving Recess Begins 11:50 a.m.
Nov. 28, Mon.	Thanksgiving Recess Ends 8 a.m.
Dec. 20, Tues.	Christmas Recess Begins 5 p.m.

1950

Jan. 4, Wed.	Christmas Recess Ends 1:10 p.m.
Feb. 7, Tues.	First Semester Graduation Exercises

Second Semester 1949-1950

Feb. 10-11, Fri.-Sat.	Second Semester Registration
Feb. 13, Mon.	Second Semester Classes Begin 8 a.m.
Apr. 4, Tues.	Spring Recess Begins 5 p.m.
Apr. 11, Tues.	Spring Recess Ends 8 a.m.
June 10, Sat.	Second Semester Ends 5 p.m.
June 12, Mon.	Second Semester Graduation Exercises

ADMINISTRATIVE OFFICERS OF THE GRADUATE SCHOOL

James Milholland, LL.B. — *Acting President*
Frank D. Kern, M.S., Ph.D., D.Sc. — *Dean*
Adrian O. Morse, M.A. — *Assistant to the President, in Charge of Resident Instruction*
J. Orvis Keller, M.S. — *Assistant to the President, in Charge of Extension*
C. S. Wyand, M.A. — *Administrative Assistant to the President*
William S. Hoffman, M.S. — *Dean of Admissions; Registrar*
Carl E. Marquardt, M.A., M.Ed., Ph.D. — *College Examiner*
Robert E. Dengler, A.M., Ph.D. — *Secretary to the Graduate Faculty*
Betty M. Moore — *Secretary to the Dean*

EXECUTIVE COMMITTEE

Frank D. Kern, M.S., Ph.D., D.Sc. — *Dean; Professor of Botany,* Chairman
Bruce V. Moore, M.A., Ph.D. — *Professor of Psychology*
John A. Sauer, M.S., Ph.D. — *Professor of Engineering Mechanics*
Alfred W. Gauger, M.A., Ph.D., *Professor of Fuel Technology; Director of the Mineral Industries Experiment Station*
David C. Duncan, M.A., Ph.D. — *Professor of Physics*
R. Adams Dutcher, M.S., A.M., D.Sc., *Professor of Agricultural and Biological Chemistry*
Robert E. Dengler, A.M., Ph.D. — *Professor of Classical Languages*
Lloyd M. Jones, M.A., Ph.D. — *Professor of Physical Education*

COURSES OF STUDY

Carl W. Hasek, M.A., Ph.D. — *Professor of Economics,* Chairman
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Earl B. Stavely, B.S., E.E. — *Professor of Electrical Engineering*
Arnold J. Currier, M.S., Ph.D. — *Associate Professor of Chemistry*
Wallace E. White, M.S., Ph.D. — *Professor of Wood Technology*
Eugen C. Bischoff, M.A. — *Professor of Physical Education*

ADMISSIONS COMMITTEE

Carl E. Marquardt, M.A., M.Ed., Ph.D., *College Examiner; Professor of Romance Philology,* Chairman
Joseph E. DeCamp, A.M., Ph.D. — *Professor of Psychology*
Harold K. Wilson, M.S., Ph.D., *Vice-Dean and Director of Resident Instruction, School of Agriculture*

BUSINESS ADMINISTRATION

Samuel K. Hostetter, *Assistant to the President, in Charge of Business and Finance*
Russell E. Clark, B.A. — *Bursar*

THE HEALTH SERVICE

Herbert R. Glenn, M.D. — *Director*

THE COLLEGE LIBRARY

Ralph W. McComb, M.A. — *Librarian*

GRADUATE FACULTY

1948-1949

James Milholland, LL.B. — *Acting President of the College*
Frank Dunn Kern, M.S., Ph.D., D.Sc., *Dean of the Graduate School; Professor of Botany*
Edward Steidle, E.M., D.Sc. — *Dean of the School of Mineral Industries*
George L. Haller, M.S., E.E., Ph.D., *Dean of the School of Chemistry and Physics*
Marion Rex Trabue, M.A., Ph.D. — *Dean of the School of Education*
Carl Peter Schott, M.A., Ph.D., *Dean of the School of Physical Education and Athletics*
Harry Parker Hammond, C.E., D.Eng., LL.D., *Dean of the School of Engineering*
Lyman E. Jackson, M.S., Ph.D. — *Dean of the School of Agriculture*
Ben Euwema, A.M., Ph.D. — *Dean of the School of the Liberal Arts*
William Stamm Hoffman, M.S., *Dean of Admissions; Secretary of the College Senate and of the Council of Administration*
Carl Eugene Marquardt, M.A., M.Ed., Ph.D., *College Examiner; Professor of Romance Philology*
Ralph W. McComb, M.A. — *Librarian*

PROFESSORS

Vernon M. Albers, M.A., Ph.D. — *Professor of Engineering Research*
Herbert Richard Albrecht, M.S., Ph.D. — *Professor of Agronomy*
Harold Freed Alderfer, M.A., Ph.D. — *Professor of Political Science*
Jean Downey Amberson, M.A., Ph.D. — *Professor of Home Economics Education*
Edgar E. Ambrosius, M.S. — *Professor of Mechanical Engineering*
Arthur von Krogh Anderson, M.S., Ph.D. — *Professor of Physiological Chemistry*
Clarence Scott Anderson, M.S., Ph.D. — *Professor of Agricultural Education*
Roy David Anthony, M.S.A., Ph.D. — *Professor of Pomology*
Harrison Heikes Arnold, M.A., Ph.D. — *Professor of Romance Languages*
John Geldart Aston, M.S., Ph.D., *Professor of Organic Chemistry; Director of the Low Temperature Laboratory*
MacLean Morton Babcock, M.S. — *Professor of Industrial Engineering*
Adam Leland Beam, M.S. — *Professor of Dairy Production*
Frederick Joseph Bedenk, M.A. — *Professor of Physical Education*
Victor A. Beede, M.F. — *Professor of Forest Management*
Franklin Lee Bentley, M.S. — *Professor of Animal Husbandry*
Thomas C. Benton, Ph.D. — *Professor of Mathematics*
Luther Lee Bernard, Ph.D. — *Professorial Lecturer in Sociology*
Robert Gibbon Bernreuter, Ph.D., *Professor of Psychology; Director of the Psychology Clinic*
Eugen Carl Bischoff, M.A. — *Professor of Physical Education*
Ralph Upshaw Blasingame, B.S. — *Professor of Agricultural Engineering*
Robert V. Boucher, A.M., Ph.D., *Professor of Agricultural and Biological Chemistry*
John Scott Bowman, M.A., Ph.D. — *Professor of English Composition*
John Robert Bracken, M.L.A., Ph.D. — *Professor of Landscape Horticulture*
Louis Jacquelin Bradford, M.E. — *Professor of Machine Design*

William Clark Bramble, M.F., Ph.D. — *Professor of Forestry*
George Elmer Brandow, Ph.D. — *Professor of Agricultural Economics*
R. Wallace Brewster, M.A., Ph.D. — *Professor of Political Science*
Henry Sherman Brunner, M.S., Ph.D. — *Professor of Agricultural Education*
Albert Franklin Buffington, M.A., Ph.D. — *Professor of German*
Clarence Edward Bullinger, I.E., M.S. — *Professor of Industrial Engineering*
Frank A. Butler, Ph.M., Ph.D. — *Professor of Education*
Ernest William Callenbach, M.S. — *Professor of Poultry Husbandry*
Clarence Raymond Carpenter, M.A., Ph.D. — *Professor of Psychology*
Carroll Dunham Champlin, M.A., Ph.D. — *Professor of Education*
Grover C. Chandlee, M.S., M.A., Ph.D., D.Sc. — *Professor of Chemistry*
Robert J. Clements, M.A., Ph.D. — *Professor of Romance Languages*
Arthur Charles Cloetingh, M.A. — *Professor of Dramatics*
Arthur Wesley Clyde, M.S. — *Professor of Agricultural Engineering*
Teresa Cohen, M.A., Ph.D. — *Professor of Mathematics*
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RALPH H. WHERRY, M.A., C.L.U. *Assistant Professor of Economics*
ALFRED FREDERICK WOELFEL, M.S., *Assistant Professor of Electrochemical Engineering*
KELLY YEATON, M.A. *Assistant Professor of Dramatics*
C. COURSON ZELIFF, M.S., Ph.D. *Assistant Professor of Zoology*
HARRY D. ZOOK, M.S., Ph.D. *Assistant Professor of Chemistry*

INSTRUCTORS

FRANCES M. ANDREWS, M.Mus., M.Ed., Ed.D. *Instructor in Music Education*
JAMES D. LEMLEY, M.S. *Instructor in Human Nutrition Research*
FRANK BRISCOE STEPHENS, M.S. *Instructor in Meteorology*

THE GRADUATE SCHOOL

THE GRADUATE SCHOOL of The Pennsylvania State College was established in 1922. Graduate instruction had been given previously under the direction of a committee of the faculty or of the College Senate. The Graduate School has general control of all questions that pertain to the interests of graduate work. The faculty consists of such members of the instructional staff as have immediate supervision of graduate courses.

In the Graduate School it is the intention to reduce routine requirements to a minimum. So far as they exist they are for the purpose of furnishing the discipline and methods necessary for independent study and investigation. It is the object of the Graduate School to surround the student with conditions that will enable him to devote himself to some chosen field. Courses of study, association with older investigators, and other aids and directions are for the promotion of independent and productive scholarship. Advanced degrees are conferred as a mark of attainment of certain standards of scholarship.

The President of The Pennsylvania State College, on recommendation of the Dean of the Graduate School, will welcome Doctors of Philosophy of The Pennsylvania State College, as well as of other accredited colleges and universities, as guests of The Pennsylvania State College, with the privilege of attending seminars and research courses and of carrying on research in the laboratories and libraries. There will be no charge except for laboratory expenses. Arrangements should be made in advance with the Dean of the Graduate School.

ADMISSION—To be admitted to the Graduate School an applicant must have received a baccalaureate degree from an accredited institution, earned under residence and credit conditions substantially equivalent to those required by The Pennsylvania State College.

For admission to the Graduate School, graduates of The Pennsylvania State College must have a minimum grade point average of 1.5 in their junior and senior years. Graduates of other institutions with different systems of grading must present equivalent standing. A student applying for admission, after having attended another graduate school where a substantial amount of credit has been earned, or a student whose career subsequent to graduation has been characterized by unusual attainments in fields having a bearing on his graduate qualifications, will be rated by a combination of the records submitted.

Admission is granted by the College Examiner. If the applicant has attended more than one institution, an official transcript of the work covered at *each* institution is required. This applies to the complete academic record, both *undergraduate* and *graduate*. Graduates of The Pennsylvania State College may present their final grade report or an official transcript of their complete record at The Pennsylvania State College at the time of their application for admission to the Graduate School here. For the convenience of graduates of teachers colleges special forms covering the undergraduate record have been prepared and should be obtained from the

Examiner. Because of the rule requiring a 1.5 average or higher during the junior and senior years of work, each applicant for admission should make every effort to have *complete* credentials in the hands of the College Examiner before the session opens in which he intends to enroll. *Official credentials should be sent directly from institutions to the Examiner.* Failure to give attention to these important matters *in advance* can lead only to delay in registration. If credentials are *not sent in advance* or are *not available at registration* this does not necessarily mean that the application for admission will be refused, but certification of credits will be withheld until the admission status has been determined.

Prospective students may make inquiries at any time regarding the possibilities of graduate study. Questions pertaining to admission should be addressed to the College Examiner. Blanks to be used in making application for admission are obtained from the Examiner. Attention is called to the fact that there are instructions on these blanks which explain in further detail the procedures of admission. General inquiries regarding graduate work may be addressed to the Dean of the Graduate School. Students should not hesitate to write directly to the head of a department if they have specific questions regarding the work of a department.

CLASSIFICATION—At the time of admission all candidates must enroll either as *Regular* or as *General* graduate students. The difference between the two groups is as follows:

Regular Graduate Students (degree candidates).—This group includes all those desiring to become candidates for degrees at The Pennsylvania State College. Their complete status is determined and conditions of candidacy arranged. A program is developed under the guidance of an adviser. There is a matriculation fee of $10 which should accompany the application for admission.

Students desiring to go forward as candidates for degrees will do well to enroll at once as regular graduate students.

General Graduate Students (nondegree candidates).—Applicants who meet all requirements for admission to the Graduate School, but who have not decided to become candidates for an advanced degree at this institution, may arrange for a program of work as general graduate students. This classification is open to those desiring to transfer credit to another institution or to those wishing to follow a certain program for the fulfillment of requirements other than those of advanced degrees. There is an *admission fee* of $1 which should accompany the application for admission.

If a student once enrolled as a general graduate student desires to become a regular graduate student, i.e., a candidate for an advanced degree, he may do so by making the necessary application to the College Examiner and by paying the $10 matriculation fee.

Not more than six credits earned as a general graduate student may be used toward the requirements for a degree.

REGISTRATION—All students must register at the beginning of each semester or summer term. The registration days are indicated in the College Calendar on page 3. Graduate students are allowed one week for registration following the

regular registration days before the late fee of $5 is imposed. *Registration must be completed within two weeks.* These regulations apply to the academic year. *There are different regulations applicable to the summer sessions which are included in the summer sessions announcements.*

The student must prepare each term a program satisfactory to the major department or group committee. When this schedule is approved by the Dean of the Graduate School the student shall present himself at the office of the Dean of Admissions and shall fill out such blanks as may be required.

The payment of the required fees at the Bursar's office completes the registration.

Under certain conditions credit may be earned by work done off the campus. Students contemplating such work should inquire of the Dean of the Graduate School about the plans and conditions. Such work must be scheduled in advance in the regular manner.

CHANGES IN THE PROGRAM—When changes in program of a graduate student are advisable they may be made with the approval of the Dean on "change of schedule" blanks. Carefully planned schedules should obviate many changes. *Necessary changes should be made promptly. In the summer sessions a delay may make changes impossible.* The foregoing statements refer to changes in specific courses. If, however, the student should decide to make a change in his major or in the degree toward which he is working, he would be required to make such change through the office of the College Examiner and his status in respect to the new major and the degree would be determined by the Examiner at that time. A fee is $1 is charged for each change of schedule except when the change is necessitated by the College.

CREDITS AND GRADES—Instructors will report in duplicate all grades for graduate students, one report to the Dean of the Graduate School, one to the Dean of Admissions. Courses bearing a number in the 500 series are marked on the basis of P (pass), H (honors), F (fail). For work taken in the 400 series a passing grade of 2 is required.

GRADUATE SCHOOL FEES

Matriculation fee (regular students)	$10.00
Admission fee (general students)	1.00
Incidental fee, each semester	50.00
General fixed fee, each semester	45.00
Off campus registration fee, each year	2.50
Graduation fee	10.00
Transcript of record (extra copy)	1.00
Change of schedule fee	1.00
Part-time fee, per credit (for less than 12 credits)	9.00

Summer session students who register for graduate courses pay the regular fees for the summer sessions.

In addition to the above fees, all full-time students who are not residents of Pennsylvania are charged a tuition fee of $110 per semester; part-time students are charged an additional $9 per credit. There is no exemption from these fees, except for scholars, fellows, and graduate assistants.

Whenever it shall appear from any of the data presented as part of the application for admission that the applicant is not a resident of Pennsylvania, the College Examiner, when admission is granted to that applicant, assumes that the one admitted is a non-Pennsylvanian. A student so admitted is held liable for the out-of-State tuition fee.

If the one who is admitted believes that his circumstances do not justify his classification as a non-Pennsylvanian, he may petition the Bursar of the College for reclassification.

Whenever such a petition for reclassification is made, the petitioner is required to present proof of bona fide continuous residence of the one admitted (or his parents, if he is a minor) within the Commonwealth for a period of not less than 12 months immediately preceding his admission; and, in addition, such other evidence as may appear pertinent to a complete review of the classification.

CANDIDACY FOR ACADEMIC AND PROFESSIONAL DEGREES

In order to be admitted to candidacy for an advanced degree the applicant must meet in full (1) the requirements for admission to the Graduate School, (2) certain undergraduate preparation necessary for the particular major chosen, and (3) must present a program approved by the major department.

ACADEMIC DEGREES

PREREQUISITE FOR CANDIDACY—Ample undergraduate preparation in the field in which the candidate intends to carry on graduate work is required. The amount of preparation cannot be stated in credits as it varies in the different departments. Full information as to what is considered adequate in the various fields and departments is on file in the office of the College Examiner. Graduate students are told at the time of their admission whether they meet the requirements for candidacy for the degree sought. Applicants who are somewhat deficient in preparation may under certain conditions be admitted to the Graduate School but not to candidacy for a degree until satisfying the requirements outlined to cover their particular case. This does not apply to a deficiency in the 1.5 scholastic average. If there is a deficiency in this regard applicants will be refused admission to the Graduate School until they have brought up their standing by further undergraduate work. Applicants who have been admitted to the Graduate School but

who lack the required undergraduate prerequisite credits for the major chosen will be allowed to follow a program satisfactory to the major department. It is likely that their program will require more than the minimum residence.

DEGREES OF MASTER OF ARTS AND MASTER OF SCIENCE

Two degrees are conferred, Master of Arts for those proceeding in the liberal arts, and Master of Science for those proceeding in science or technology.

REQUIREMENTS—A course for the master's degree requires a minimum of 30 credits and consists of one major and not more than two minor subjects. The program requires the equivalent of one academic year (two semesters), or at least 30 weeks, and may be met by full-time residence, part-time work, attendance in the summer sessions, or by any combination of these. Students not adequately prepared, or assistants and other part-time students, will require more than this time to attain the master's degree. Three credits earned in residence at another approved institution or in the extension classes of The Pennsylvania State College under certain conditions may be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within a period of six years.

At least 12 credit hours and a thesis equivalent of 6 credits must be devoted to the major subject. Twelve credits may be offered in courses open to upper-class and graduate students (courses with 400 numbers). A student's program must be approved by the head of the major department and the Dean.

Choice of the major and minor subjects must be dependent upon adequate preparation. Except by permission of the Dean, one minor subject must be chosen in a field of study different from that of the major. The mere completion of a stated amount of work does not entitle a candidate to recommendation for a degree. He must pass examinations upon such subjects and at such times as shall be designated by the departments concerned and must present an acceptable thesis.

THESIS—Under the direction of the department in which the candidate's major subject is taken, he must prepare a thesis upon a suitable topic related to that subject. Under certain conditions a student may be permitted to complete the thesis *in absentia.* To obtain such permission the student must make satisfactory arrangements both with the major department and with the Office of the Dean.

For instructions concerning the form and the filing of typewritten copies of the thesis, see page 28.

DEGREE OF DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy (Ph.D.) is conferred in recognition of high attainments and productive scholarship in some special field of learning as evidenced (1) by the satisfactory completion of a prescribed period of study and investigation; (2) by the preparation of a dissertation involving independent research; and (3) by successfully passing examinations covering both the special subject and the general field of learning of which this subject forms a part.

RESIDENCE REQUIREMENTS—A minimum of three academic years of resident graduate study and research are required for the attainment of a doctor's degree. Students not devoting full time to graduate study will be required to extend their work over a longer period. Credit for part-time work will be based on the actual time spent in the pursuit of graduate work. Work of equal grade done in residence at other institutions and residence for a master's degree, may be accepted by the College Examiner and the faculty as partial fulfillment of the requirements, but at least one academic year must be spent at this institution. While the minimum residence requirements must be met, it is understood that the time requirement is secondary to other considerations.

One-third of the residence requirements for a Ph.D. degree may be met by research work away from the College in branch laboratories of the College, or research laboratories not connected with other degree-granting institutions, or in other centers where there are opportunities for research under the following conditions:

(a) The candidate shall have had at least one year's work in residence.

(b) The plan must have the approval of the group committee.

(c) Reports on the work shall be made as directed by the group committee.

A candidate for a doctor's degree, doing graduate work off the campus, may obtain in this manner a maximum of six credits in an academic year, September to June, or nine credits in a calendar year. This does not apply to resident students temporarily assigned to other locations when, in the judgment of the Dean of the Graduate School, and the head of the department concerned, such assignment seems desirable.

Work done off the campus, which is to be credited towards a doctor's degree, must be scheduled *in advance* with the Dean of the Graduate School and the Dean of Admissions.

WORK DONE ELSEWHERE—Acceptance of residence in another institution as partial fulfillment of the requirements toward an advanced degree, shall be by authority of the College Examiner. In determining to what extent the work done elsewhere may meet the course requirements at this institution each case will be decided on its merits by the group committee, or by the Dean and the heads of the departments concerned.

PROGRAM OF WORK—A program shall consist of a major and one or two minor subjects. Two-thirds of the total time is to be devoted to the major subject. A division of the remaining one-third of the total time on the basis of two to one between the first and second minors is satisfactory. The heads of the major and minor departments or their representatives, together with the Dean, constitute a special group committee which shall have general charge of the arrangement of the program.

For the first year of graduate study leading to the doctor's degree, 30 credit hours is considered a full-time program. The first year's work may be substantially the same as that provided for the master's degree, and may lead to that degree, although that is not necessary.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied

the major department that he is prepared to proceed and is recommended by his group committee.

There is no specified number of courses or credits for the attainment of the doctor's degree. A program shall consist of such a combination of courses and research as is approved by the group committee for each individual student. Students devoting only a portion of their time will be credited on their residence requirements in proportion to the time actually spent in graduate study and research.

DISSERTATION—The ability to do independent research must be proved by the preparation of a dissertation on some topic in connection with the major subject. It should represent a contribution on some worth-while problem presented in a scholarly manner. The contents and conclusions of the dissertation must be defended at the time of the final examinations.

The general subject of the dissertation must be determined at the time of admission to candidacy for the degree, and the completed dissertation, typewritten in triplicate copy, must be filed in the office of the College Librarian not later than one week prior to the commencement at which the candidate expects to take the degree.

For regulations concerning the form and the filing of the dissertation, see page 28.

EXAMINATIONS—Preliminary or qualifying examinations are required in the major and minor subjects to determine whether the candidate has made satisfactory progress and is entitled to the privilege of completing the requirements for the degree. These examinations are scheduled at a time when one-third of the residence requirements remain to be satisfied. They are given by a committee representative of the departments concerned and such other members as the Dean may appoint. The candidate must have satisfied the language requirements before taking the preliminary examinations.

Candidates for the degree of Doctor of Philosophy are required to have a reading knowledge of French and German unless an exception is arranged. Upon the recommendation of the major department and the approval of the Dean, the substitution of another foreign language may be authorized for either French or German. In the case of foreign students, German and English will commonly serve as the foreign languages, unless one of these be the mother tongue. Certificates of proficiency must be obtained from the respective language departments of this College, or from the College Examiner provided language requirements have been met at another institution. Candidates not presenting certification of reading ability at the time of admission should make immediate arrangements to acquire that ability either through class work or by tutoring. The language requirements must be satisfied prior to the scheduling of the preliminary examinations.

The final examination for the doctor's degree is conducted by a committee representative of the departments concerned and such other members as may be appointed by the Dean, who shall also designate the time and place. The examination is oral, open to the public, and covers the whole field of study of the candidate without regard to courses that may have been taken either here or elsewhere.

PROFESSIONAL DEGREES IN EDUCATION

PREREQUISITES FOR CANDIDACY—In order to provide graduate work which would utilize more fully the professional training and background of those holding bachelors' degrees from teachers colleges and schools of education, these professional degrees in education were established.

All candidates are required to have had at least 27 undergraduate credits in the field of education, including practice teaching. If a candidate elects to specialize in a subject-matter field, then certain additional prerequisites are required for that subject. The amount of preparation varies in the different fields. Full information concerning the preparation required by the various departments is on file in the office of the College Examiner. If there are deficiencies at the time of admission they must be removed before candidacy for a degree is completed. While making up deficiencies in prerequisite credits a student must follow a program satisfactory to the major department. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School until applicants have brought up their standing by further undergraduate work.

Candidates for the advanced degrees in education are required to take a qualifying comprehensive examination before completing the second half of their course requirements, which serves as a guide in outlining a program of study that will meet the individual needs of the candidate.

DEGREE OF MASTER OF EDUCATION

The degree of Master of Education represents general scholarship, acquaintance with the chief phases of educational literature, teaching skill, qualities of leadership in educational work, and ability to solve concrete problems in at least one special field of education.

The following regulations govern candidacy for the degree of Master of Education:

RESIDENCE AND COURSE REQUIREMENTS—A minimum of 30 credits, 6 of which may be granted for an approved thesis. The program requires the equivalent of one academic year (two semesters), or at least 30 weeks, and may be met by full-time residence, part-time work, attendance in the summer sessions, or any combination of these. Three credits earned in residence at another approved institution or in extension classes of The Pennsylvania State College, under certain conditions may be offered as partial fulfillment of the requirements. All requirements must be met within a period of six years.

A minimum of 24 credits is to be earned in graduate course work. It is expected that the larger part of this work shall be in courses open only to graduate students but the needs of the student shall be considered in arranging the best combination of courses (400 and 500 series) for the preparation of the candidate in his special field.

If a student looks forward to a career as a teacher, he may specialize in a specific field (as English, mathematics, Latin, etc.), and that shall be regarded as the major field, and a majority of the work is to be taken there. If a broader field

is sought, a group major may be chosen (as social studies, general science, etc.). In this case a larger percentage of the 24 credits is to be devoted to the subjects forming the group major. The remainder of the program is devoted to a minor in the field of education, consisting of approximately one-third of the required credits, depending on the previous preparation, experience, and objectives of the candidate. In case the candidate's undergraduate preparation has not included courses in the scientific study of education and advanced educational psychology, a course in each of these fields must be included.

Those desiring to prepare as supervisors and administrators may choose a major and a minor within the curricula of Education. The following fields are recommended: secondary school principal, elementary school principal, superintendent of schools, guidance counselor, vocational director, or supervisor.

The candidate may choose one field of work for a major and another field for a minor. These majors prepare for State certificates in those fields where special certificates are given. It is possible to arrange programs of study concentrated in other fields.

ADVISORY COMMITTEE—The heads of the major and minor departments or fields (or their representatives) together with the supervisor of the problem course (thesis) constitute a special advisory committee which shall approve the study program. In practice the general guidance of a student is centered in an adviser from the major department, who is familiar with the field in which the student is specializing.

THESIS—Under the direction of a supervisor representing the major department or major field, an amount of time equivalent to six credits may be devoted to problem work and the preparation of a thesis. Under certain conditions this may be carried out in part *in absentia,* particularly when requirements are met by summer session attendance.

Course work may, under certain conditions, wholly or in part, take the place of the problem and thesis work. Application for the opportunity to substitute six credits of course work for the thesis must be filed with the candidate's advisory committee or adviser before the candidate completes more than 12 of the 30 credits required for the degree. The application must include the statement of the major and the titles and numbers of the courses which the candidate wishes to submit in substitution for the thesis.

For instructions concerning the form and the filing of the thesis, see page 28.

EXAMINATIONS—Candidates for the Master of Education degree must pass a final comprehensive examination. The examination will be designed to determine the ability of the candidate to apply the general, as well as the special, knowledge of his chosen field in practical situations.

DEGREE OF DOCTOR OF EDUCATION

The degree of Doctor of Education is conferred in recognition of scholarship and teaching or administrative skill as evidenced by (1) the satisfactory completion of a prescribed period of study, (2) the application of scientific principles in class-

room teaching, in the supervision of instruction, or in administrative work, (3) by the preparation of a dissertation demonstrating ability to attack an educational problem with originality and independent thought, (4) by successfully passing examinations showing a satisfactory grasp of the field of specialization and its relation to allied subjects, and (5) by recognized leadership in the profession of education.

RESIDENCE—An equivalent of three years of graduate study is required as a minimum for the doctor's degree. However, it is not required that the three years be continuous. Graduate study may be carried on through a longer period and paralleled by teaching or administrative work.

Work of equal grade done in residence at other institutions, and residence for a master's degree, may be accepted as partial fulfillment of the requirements, but in addition, at least one academic year or its equivalent must be spent in residence at this institution. For students pursuing work beyond the master's degree a combination of sessions amounting to at least 30 weeks is regarded as the equivalent of an academic year. While it may be possible to fulfill the minimum residence requirement as just stated, it is expected that candidates for the doctorate will be taking a much greater amount of work in the institution. Those completing requirements in summer sessions will continue during the regular school year in some educational situation, under the guidance of members of the faculty, study and research programs set up in summer courses.

One-third of the requirements (equivalent to a 30-credit year) for the degree of Doctor of Education may be met by research work pursued away from the campus in the school systems of the State, or in other approved centers not connected with degree-granting institutions, provided (1) the plan be approved by the student's advisory committee, (2) reports on the projects be made as directed by the advisory committee, (3) not more than six credits be earned in an academic year, September to June, or nine credits in a calendar year.

Work done off the campus, which is to be credited toward a doctor's degree, must be scheduled *in advance* with the Dean of the Graduate School and the Dean of Admissions.

PROGRAM OF STUDY—The program of study shall be so arranged as to lead toward high professional mastery within some area of educational service. A majority of the courses offered in fulfillment of the requirement will be in the major field of study. The remainder shall be in one or two minors bearing some functional relation to the major and to the work the candidate is planning to do. These minors may be in academic subjects or in some phase of education or psychology other than the major. In the case of persons intending to continue in classroom teaching rather than in administrative or supervisory positions, a larger proportion of the work may be assigned to the academic fields in which the candidate is teaching, to whatever extent the advisory committee may believe the background and the objectives of the particular candidate warrant. But every candidate for the degree of Doctor of Education must show through a comprehensive examination that he is familiar with current theories of education; that he understands and can apply the techniques and the findings of educational research so far as they bear upon the teaching of his subject; that he is prepared to read understandingly, and to contribute to, the technical professional literature in his field; and that he can criticize

his own procedures in the light of historical trends and practices in this and other countries.

Command of the tools for a thorough study of the problems of education is necessary and must include familiarity with statistical methods. For certain students the requirements may include a reading knowledge of one or more foreign languages.

There is no specified number of courses or credits for the attainment of the doctor's degree. The general requirements are based not upon courses or credits but upon a definite residence, a satisfactory dissertation, the passing of a comprehensive examination, and possession of the qualities of professional leadership. A program shall consist of such a combination of courses and individual study and research as is approved by the advisory committee for each student.

ADVISORY COMMITTEE—The heads of the major and minor departments or fields (or their representatives), the supervisor of the dissertation, together with the Dean of the Graduate School, constitute a special advisory committee which shall have charge of the arrangement of the study program.

DISSERTATION—Evidence of a high degree of scholarship and ability to select, organize, and apply knowledge must be presented by the candidate in the form of a written dissertation. The candidate must demonstrate capacity for independent thought and ability and originality in the application of educational principles or in the development of new generalizations under scientific controls. The topic and outline of the proposed thesis must have the approval of the advisory committee.

For instructions concerning the form and filing of the dessertation, see page 28.

EXAMINATION AND ADMISSION TO CANDIDACY—In order to be admitted to full candidacy for the degree each candidate shall pass preliminary qualifying examinations administered by the committee on qualifying examinations. The qualifying examinations may not be taken until after one semester of work has been completed at this institution. They are scheduled at a time when one-third of the residence requirements remain to be satisfied. Examinations will be held at times arranged with the head of the major department. The qualifying examinations will be designed to test (1) the candidate's general scholastic preparation and professional background; and (2) his ability to integrate and apply his knowledge in his fields of specialization to practical situations so as to reflect an intelligent mastery of the subjects.

Three of the important factors taken into consideration in passing judgment upon the application of a candidate for admission to candidacy are:

(a) Previous scholastic record at this institution and other institutions attended;

(b) Achievement in qualifying examinations;

(c) Estimates of his personal and professional qualifications by members of the advisory group.

The advisory committee will make recommendations to the Dean of the Graduate School, and candidates will be advised of the decision with regard to their applications for candidacy within 10 days following the date of each qualifying examination.

Candidates who have fulfilled all other requirements for the degree will, on recommendation of their advisory committee, be permitted to take the final oral examination for the degree. The committee in charge of this examination will consist of the student's advisory committee and others appointed by the Dean of the Graduate School. The examination will be based upon the dissertation and related problems. Arrangements for taking the final examination must be made with the Dean of the Graduate School, through the advisory committee and the major department, not later than two weeks prior to a commencement date.

PROFESSIONAL DEGREE IN FORESTRY

The degree of Master of Forestry represents scholastic ability, acquaintance with forestry literature, and technical knowledge of one or more of the several specialized fields in forestry or wood utilization. It is offered to provide an opportunity for additional study in a student's particular field of interest, rather than for research work on a special problem, though such work is not precluded under the requirements for the degree.

PREREQUISITES FOR CANDIDACY—A candidate is required to hold a baccalaureate degree, or its equivalent, from a recognized professional school of forestry. Full information concerning the preparation required in either general forestry or wood utilization is on file in the office of the College Examiner. If there are deficiencies at the time of admission they must be removed before candidacy for a degree is completed. While making up deficiencies in prerequisite credits, the student must follow a program approved by his advisory committee. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School until applicants have brought up their standing by further undergraduate work.

RESIDENCE AND COURSE REQUIREMENTS—A minimum of 30 credits is required for the degree of Master of Forestry. These credits are to be taken in the best arrangement of courses bearing 400 and 500 numbers suited to the needs of the individual student. Although not required, a maximum of 6 credits may be assigned to a thesis upon approval and recommendation of the head of the Forestry Department. All requirements must be met within a six-year period.

A maximum of three credits may be earned in extension classes of The Pennsylvania State College, or in resident classes of other approved institutions, provided these credits have the approval of the College Examiner and fit into the program of the student.

A student should choose one field of work for his major interest with one or two related minor fields. The proportion of credits to be taken in the major and minor fields of study will be determined in consultation with an advisory committee. Ordinarily this committee consists of the head of the Forestry Department, and the professors in charge of the major and minor fields.

TECHNICAL DEGREES

ADMISSION—A graduate of the School of Chemistry and Physics, of the School of Engineering, or of the School of Mineral Industries of The Pennsylvania State College may be admitted to candidacy for a technical degree, provided he submits evidence of having been engaged for a period of not less than three years in acceptable professional work in the field of engineering in which the application for the degree is made.

A technical degree may also be granted to an engineer of approved practical experience, who is a graduate in engineering of another institution of equal standing, on completion of at least three years of full-time teaching or research work in engineering in a professional rank in this institution and upon presentation of an acceptable thesis and the fulfillment of all other requirements for technical degrees. Applicants who are eligible for the technical degrees are admitted to the Graduate School by the College Examiner.

REGISTRATION—The candidates for technical degrees must file with the College Examiner an application filled out in duplicate on the prescribed forms, approved by the head of the department in which the undergraduate work was completed. The application should be accompanied by the matriculation fee of $10.

The times for registration for these degrees are the same as for resident students. A candidate must be registered during two regular sessions.

DEGREES AND REQUIREMENTS—The technical degrees are as follows: Architectural Engineer, Chemical Engineer, Civil Engineer, Electrical Engineer, Fuels Engineer, Industrial Engineer, Ceramic Engineer, Mechanical Engineer, Engineer of Mines, Metallurgical Engineer, Petroleum Engineer.

Not less than three years shall have elapsed from the time of receiving the first degree before a graduate of this institution shall be permitted to file his application for a technical degree. The application for a technical degree shall include evidence of a satisfactory professional record, which must be approved by the executive committee of the undergraduate School concerned.

In order to be recommended for a technical degree the candidate must prepare a thesis on a subject related to his profession. He must register in the manner specified in the foregoing paragraph and pay the registration and diploma fees. He may be required to appear in person to defend his thesis.

THESIS—Immediately following registration the candidate must submit for approval an outline of his proposed thesis, and at least six weeks prior to the day on which the degree is to be conferred, the complete thesis must be in the office of the head of the department concerned.

For regulations concerning the form and filing of the thesis, see page 28.

FEES—Each candidate for a technical degree must pay a matriculation fee of $10 and a diploma fee of $10 when recommended to the College Senate for the degree. The matriculation fee is payable through the Office of the College Examiner, whereas the diploma fee is payable through the Office of the Bursar. Both fees are payable by check drawn to the order of The Pennsylvania State College.

REGULATIONS FOR THESES AND DISSERTATIONS

THESES—It is required that three typewritten copies must be presented. They are due in the office of the College Librarian not later than one week prior to the day on which the degree is to be conferred.

Before arranging for the typing the candidate must obtain information from the College Librarian concerning the format, paper, illustrations, etc.

A thesis thus submitted and approved becomes wholly the property of the College, and may not be published, in whole or in part, without authorization of the Dean of the Graduate School and the head of the department concerned.

These regulations apply to candidates for the master's and technical degrees.

DISSERTATIONS—Candidates for the doctor's degree must satisfy one of the following requirements as to the dissertation not later than one week prior to the day on which the degree is to be conferred:

1. Publication of the dissertation in a manner satisfactory to the College Librarian and deposit of 100 copies in the College Library; or

2. Presentation of a typewritten abstract, satisfactory to the major department and the College Librarian, and the sum of $35. The Librarian will then arrange for the printing of the abstract. Fifty copies of the printed abstract will be furnished to the candidate without additional cost.

Before arranging for the typing or publication of the dissertation, or the abstract, the candidate must obtain information regarding the format, title page, etc., from the College Librarian.

The regulations apply to candidates for the Doctor of Philosophy and Doctor of Education degrees.

GRADUATE ASSISTANTSHIPS AND OTHER AIDS

A number of appointments as teaching or research assistants, or awards as fellows, or scholars, are available with varying stipends and exemption from the incidental fee, the general fixed fee, and the out-of-State tuition fee. A health service fee of $7.50 is assessed. Applications should be made to the head of the department in question. The graduate program that can be carried is proportioned to the service rendered.

GRADUATE ASSISTANTSHIPS—Appointments for 9 months, September 15 to June 15 (stipend $1008), or for the fiscal year (stipend $1344); service one-half time; program two-thirds.

SPECIAL GRADUATE ASSISTANTSHIPS—Appointments for 9 months (stipend $1512), or for the fiscal year (stipend $2016); service three-fourths time; program one-half.

GRADUATE STIPEND SCHOLARSHIPS—Appointments for 9 months (stipend $504), or for fiscal year (stipend $672); service one-fourth time; program four-fifths.

DU PONT FELLOWSHIP IN CHEMISTRY—Candidate recommended by the Department of Chemistry and approved by a member of the fellowship committee of the du Pont Company (stipend $750).

RESEARCH AND INDUSTRIAL FELLOWSHIPS—Numerous fellowships offered by various outside agencies for the investigation of special problems (stipends vary). Information is obtainable from the departments.

THE JOHN W. WHITE FELLOWSHIPS—Awarded to two graduates of The Pennsylvania State College each year on the basis of scholarship, need, character, and attitude.

THE ELLIOTT FELLOW IN ENGINEERING RESEARCH—An annuity provided by W. S. Elliott, of Pittsburgh, for a student in engineering who must be a graduate of this College.

GRADUATE SCHOLARSHIPS—A limited number of scholarships without stipends, but with exemption from the incidental, general fixed, and out-of-State tuition fees, are assigned to the various departments. The holders are required to render some service, but a master's degree may be earned on the basis of one academic year. Applications may be made to the Dean of the Graduate School, or to the head of the department in question.

GRADUATE COURSES OFFERED BY THE VARIOUS DEPARTMENTS

The course descriptions which follow are arranged alphabetically, with some exceptions, according to departments. If any specific course cannot be located readily, refer to the table of contents, page 2.

The courses of instruction in all departments of the College are numbered in accordance with a unified plan, as follows:

UNDERGRADUATE COURSES, numbered 1 to 399, are general courses accepted in fulfillment of the requirements for the bachelor's degree.

UPPER-CLASS AND GRADUATE COURSES, numbered 400 to 499, are advanced courses open for credit to undergraduate students of at least junior standing and to graduate students under the restriction that no more than nine credits in these courses may be offered in fulfillment of the requirements for the degrees of M.A. and M.S.

GRADUATE COURSES, numbered 500 to 599, are special courses for graduate students only. The name of the person in charge of the instruction for the course usually follows the description. Senior students of The Pennsylvania State College not required to carry a full program for graduation, with permission of the Dean of the School in which they are enrolled and of the Dean of the Graduate

School, may attend such courses and be allowed credit under special conditions. *Many departments reserve the right to say which of certain graduate courses may be given in any semester; the heads of departments should be consulted.*

The figures in parentheses following the title of the course indicate the number of credits granted for that course. A considerable number of graduate courses are offered in the summer sessions. When these courses are also given during the regular academic year they are not listed separately as summer session courses in this announcement. For a complete list of courses given during a specific summer or summer session, consult the *Complete Announcement of the Summer Sessions* for that particular year. In this announcement courses given during the summer session (*but not during the regular academic year*) have numbers followed by the letter "S." Courses given in extension only have numbers followed by the letter "X."

AERONAUTICAL ENGINEERING

PROFESSOR DAVID J. PEERY, M.S.E., C.E., Ph.D.
Head of the Department

AERO.E. 501. AIRPLANE STABILITY AND CONTROL (3).—General analysis of longitudinal and lateral stability of airplanes; characteristics of flight control devices. Prerequisite: Aero.E. 403. Lecture 3 hours. *Professor D. J. Gildea*

AERO.E. 502. AIRCRAFT PROPELLER DESIGN (3).—Propeller characteristics by blade element analysis and test data; blade design and stress analysis; pitch changing mechanisms. Prerequisites: Aero.E. 403, M.E. Des. 6, 8. Lecture 3 hours. *Professor D. J. Gildea*

AERO.E. 503. AIRPLANE PERFORMANCE (3).—Analytical approach to airplane performance problems; reduction of flight test data. Prerequisite: Aero.E. 403. Lecture 3 hours. *Professor D. J. Gildea*

AERO.E. 504. ROTARY WING AIRCRAFT (3).—Types of rotary wing aircraft, rotor arrangements, power transmission, and control mechanisms; helicopter performance in vertical and forward flights; dynamic and aerodynamic loads on rotor blades. Topics are treated in more detail and at higher level than in Aero.E. 407. Prerequisites: Aero.E. 403, 409. Lecture 3 hours. *Professor D. J. Peery*

AERO.E. 505. AIRCRAFT VIBRATION AND FLUTTER (3).—Vibrating systems with several degrees of freedom; analysis of flutter speed of an airplane wing considering bending, torsion, and aileron motions; other types of aircraft flutter. Prerequisites: Aero.E. 1, M.E. Des. 8. Lecture 3 hours. *Professor D. J. Peery*

AERO.E. 506. ADVANCED AIRCRAFT STRUCTURES (3).—Deflections of beams and trusses; statically indeterminate structures; shear-flow analysis and shearing deformations of multi-cell semi-monocoque structures; effects of discontinuities in wing and fuselage structures. Prerequisite: Aero.E. 409. Lecture 3 hours. *Professor D. J. Peery*

AERO.E. 507. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3).—History and theory of gas turbines for propeller and jet propulsion installations; theoretical and design analysis of various combinations of the basic elements; compressor, combustion chamber, and turbine. Topics are treated in more detail and at higher level than in Aero.E. 408. Prerequisite: M.E. 413. Lecture 2 hours, practicum 3 hours. *Professor S. K. Hoffman*

AERO.E. 508. ADVANCED AIRCRAFT ENGINE DESIGN I (4).—Fundamental principals of design of aircraft engines; performance and stress computations. Assembly drawings of a complete engine are started. Prerequisite: M.E. 413. Lecture 2 hours, practicum 6 hours. *Professor S. K. Hoffman*

AERO.E. 509. ADVANCED AIRCRAFT ENGINE DESIGN II (4).—Continuation of stress computations and assembly drawings begun in Aero.E. 508; completion of design report. Prerequisite: Aero.E. 508. Lecture 2 hours, practicum 6 hours. *Professor S. K. Hoffman*

AERO.E. 510. AERODYNAMICS OF COMPRESSIBLE FLUIDS (3).—One-dimensional motion, shock waves, flow through nozzles and other channels; airfoils in high-speed flow, critical Mach number; subsonic, transonic, and supersonic regions. Prerequisites: Aero.E. 1, Math. 84, M.E. 2. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AERO.E. 401 a,b,c. AERONAUTICAL ENGINEERING PROJECTS (2-12)
AERO.E. 402. AIRPLANE ENGINE DESIGN (5) *Professor S. K. Hoffman*
AERO.E. 403. APPLIED AERODYNAMICS (3) *Professor D. J. Gildea*
AERO.E. 404. AIRPLANE DESIGN (5) *Professor D. J. Gildea*
AERO.E. 407. ROTARY WING AIRCRAFT (3) *Professor D. J. Peery*
AERO.E. 408. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3) *Professor S. K. Hoffman*
AERO.E. 409. AIRPLANE DETAIL DESIGN (4) *Professor D. J. Peery*
AERO.E. 410. AIRPLANE POWER PLANTS (4) *Professor S. K. Hoffman*

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

PROFESSOR R. ADAMS DUTCHER, M.S., A.M., D.Sc.
Head of the Department

AGR. BIOCHEM. 501. ENZYMES (2).—Lectures and assigned reading reviewing investigational work and recognized theories concerning the probable nature of enzymes, enzyme action, influence of chemical environment on enzyme action, and biological applications. Prerequisite: Agr. Biochem. 417. Lecture 2 hours. *Professor C. O. Jensen*

AGR. BIOCHEM. 502. PHYSICAL CHEMISTRY OF THE CELL (3).—Lectures and assigned reading reviewing current literature relative to physical chemistry of living tissues and life processes. Prerequisite: Agr. Biochem. 426. Lecture 3 hours. *Professor M. W. Lisse*

AGR. BIOCHEM. 503. RESEARCH (3-15).—The prosecution of an assigned problem under the guidance of an instructor. Prerequisite: Agr. Biochem. 417. For certain problems additional courses may be considered as prerequisite. *Professor R. A. Dutcher and Staff*

AGR. BIOCHEM. 504. THESIS RESEARCH (3-15 per semester). *Professor R. A. Dutcher and Staff*

AGR. BIOCHEM. 505. VITAMINS AND DIETARY DEFICIENCY DISEASES (2).—Lectures, conferences, and assigned reading. Prerequisite: Agr. Biochem. 437. *Professor R. A. Dutcher*

AGR. BIOCHEM. 506. VITAMIN ASSAY METHODS (2).—Lectures, conferences, and demonstrations dealing with approved methods of vitamin assay and including demonstrations of typical vitamin deficiency syndromes in the rat. Prerequisite: Agr. Biochem. 505. *Professor N. B. Guerrant*

AGR. BIOCHEM. 507a. SEMINAR IN PHYSIOLOGICAL CHEMISTRY AND NUTRITION (1).
Professors R. A. Dutcher, N. B. Guerrant, A. K. Anderson, R. V. Boucher, R. C. Miller, G. H. Pritham

AGR. BIOCHEM. 507b. SEMINAR IN FOODS AND ANALYTICAL CHEMISTRY (1).
Professors H. O. Triebold, P. M. Althouse

AGR. BIOCHEM. 507c. SEMINAR IN PLANT, SOIL, AND INSECTICIDE CHEMISTRY. (1). *Professors D. E. H. Frear, C. O. Jensen*

AGR. BIOCHEM. 508. RESEARCHES IN PLANT CHEMISTRY (3).—Lectures and assigned readings reviewing the more important chemical investigations in plant chemistry. Prerequisite: Agr. Biochem. 437. Lecture 3 hours.
Professor C. O. Jensen

AGR. BIOCHEM. 509. BIOCHEMICAL METHODS (3).—An advanced laboratory course involving special methods used in biochemical research on plant and animal materials. Prerequisite: Agr. Biochem. 437. Practicum 9 hours.
Professor A. K. Anderson

AGR. BIOCHEM. 510. PROTEINS (2).—The chemical constitution of proteins, their physical and biochemical properties, their function in nutrition, and their fate in metabolism. Prerequisite: Agr. Biochem. 437. Lecture 2 hours.
Professor A. K. Anderson

AGR. BIOCHEM. 511. CARBOHYDRATES (2).—Study of research work dealing with the carbohydrates and their metabolism in the plant and animal organisms. Prerequisite: Agr. Biochem. 437. Lecture 2 hours. *Professor C. O. Jensen*

AGR. BIOCHEM. 512. LIPIDS (2).—Investigations on the biochemistry of fats and related substances. Prerequisite: Agr. Biochem. 437. Lecture 2 hours.
Professor H. O. Triebold

AGR. BIOCHEM. 513. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (4).—Laboratory course, quantitative in nature, valuable as preparation for Agr. Biochem. 502. Hydrogen-ion concentration, electrometric titration, buffers, oxidation-reduction potential, and membrane potential. Prerequisite: Agr. Biochem. 425 or Chem. 41, 43. Lecture 2 hours, practicum 6 hours.
Professor M. W. Lisse

AGR. BIOCHEM. 514. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (3).—Continuation of Agr. Biochem. 513.
Professor M. W. Lisse

AGR. BIOCHEM. 515. BIOMETRY (2).—The application of statistical methods to research problems in biochemistry and biology. Prerequisites: Agr. Biochem. 437, Math. 30. *Professor R. C. Miller*

AGR. BIOCHEM. 516. CHEMISTRY OF INSECTICIDES AND FUNGICIDES (2).—Lectures and assigned readings dealing with chemical investigations of materials used in the control of insects and plant diseases. Prerequisites: Chem. 30, 31; Agr. Biochem. 425 or Chem. 41, 43; Agr. Biochem. 417. Lecture 2 hours.
Professor D. E. H. Frear

AGR. BIOCHEM. 517. ENDOCRINE SECRETIONS (2).—Chemistry of hormones and their physiological significance. Prerequisite: Agr. Biochem. 437. Lecture 2 hours. *Professor G. H. Pritham*

AGR. BIOCHEM. 518. MINERAL METABOLISM (2).—Utilization and function of the mineral elements in animal nutrition. Prerequisite: Agr. Biochem. 437. Lecture 2 hours. *Professor R. V. Boucher*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. BIOCHEM. 403. DAIRY CHEMISTRY (3) *Professor H. O. Triebold*
AGR. BIOCHEM. 404. FOOD CHEMISTRY (4) *Professor H. O. Triebold*
AGR. BIOCHEM. 405S. BIOLOGICAL CHEMISTRY FOR TEACHERS OF HIGH SCHOOL SCIENCE (3)
AGR. BIOCHEM. 413. PRINCIPLES OF ANIMAL NUTRITION (3) *Professor R. C. Miller*
AGR. BIOCHEM. 417. METHODS OF AGRICULTURAL ANALYSIS (4) *Professor H. O. Triebold*
AGR. BIOCHEM. 418. PLANT ANALYSIS (4) *Professor C. O. Jensen*
AGR. BIOCHEM. 421. CHEMISTRY OF MILLING AND BAKING (3) *Professor H. O. Triebold*
AGR. BIOCHEM. 425. BIOPHYSICAL CHEMISTRY (4) *Professor M. W. Lisse*
AGR. BIOCHEM. 426. BIOCOLLOIDS (3) *Professor M. W. Lisse*
AGR. BIOCHEM. 427. POTENTIOMETRIC THEORY AND TECHNIQUE (3) *Professor M. W. Lisse*
AGR. BIOCHEM. 437. GENERAL BIOCHEMISTRY (5) *Professors A. K. Anderson, G. H. Pritham*
AGR. BIOCHEM. 438. PHYSIOLOGICAL CHEMISTRY (CLINICAL METHODS) (5) *Professor A. K. Anderson*
AGR. BIOCHEM. 439. PROBLEMS IN AGRICULTURAL CHEMISTRY (3-5) *Professor R. A. Dutcher and Staff*
AGR. BIOCHEM. 440. PLANT BIOCHEMISTRY (3) *Professor C. O. Jensen*

AGRICULTURAL ECONOMICS

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.
Head of the Department of Agricultural Economics and Rural Sociology

AGR. EC. 500. SEMINAR IN AGRICULTURAL ECONOMICS (1-6).—A review of current literature and problems. Lecture 1 hour per credit.

AGR. EC. 501. APPLIED THEORY IN AGRICULTURAL ECONOMICS (3).—Economic principles having important application to agriculture; agricultural organization and current farm problems in the light of principles of economic theory. Prerequisite: 6 credits in agricultural economics or economics. Lecture 3 hours. *Professor G. E. Brandow*

AGR. EC. 502. ECONOMIC PROBLEMS IN THE MARKETING OF FRUITS AND VEGETABLES (3).—Economics of marketing fruits and vegetables in fresh and pro-

cessed form; comparative advantage of various areas of production, consumption trends, costs and methods of distribution, influence of governmental policies, and types of marketing organizations. Conference 3 hours. *Professor W. A. Lee*

AGR. EC. 503. RESEARCH METHODS IN FARM MANAGEMENT (1-3).—Evaluation of research procedures, methods, results, and needs in the field; emphasis on their application to specific research problems. Prerequisites: Agr. Ec. 6, Econ. 14. Recitation 1 to 3 hours.

AGR. EC. 505. ADVANCED AGRICULTURAL STATISTICS (3).—Application to problems in rural social sciences of methods of sampling, measures of relationship, techniques of prediction, and tests of statistical significance. Prerequisite: 3 credits in statistics. Lecture 3 hours. *Professor G. E. Brandow*

AGR. EC. 507. SEMINAR IN FARM MANAGEMENT (1-6).—Special problems relating to the organization and operation of the farm business. Prerequisites: Agr. Ec. 6, Econ. 14.

AGR. EC. 515. ECONOMIC PROBLEMS IN THE MARKETING OF DAIRY PRODUCTS (3).—Economic problems as they are encountered in the process of marketing; particular attention to governmental regulation in pricing and marketing. *Professor C. W. Pierce*

AGR. EC. 517. PROBLEMS AND POLICIES OF FARMER CO-OPERATIVES (3).—Specific types of co-operative organizations, their problems, policies, and progress; relationships existing among co-operatives, between co-operatives and other business organizations, and between co-operatives and the public. Prerequisite: Agr. Ec. 17. Lecture 3 hours. *Professor J. K. Stern*

AGR. EC. 525. RESEARCH METHODS IN RURAL SOCIAL SCIENCES (2).—The scientific method in planning and conducting research in agricultural economics and rural sociology; interviewing, use of questionnaires, qualitative analysis, quantitative analysis, sampling, control groups, scales, indices, and thesis writing. Prerequisite: 9 credits in social science. Lecture 2 hours. *Professor M. E. John*

AGR. EC. 533. ECONOMIC PROBLEMS IN THE MARKETING OF POULTRY AND EGGS (3).—Detailed treatment of special problems such as the marketing of particular types and grades of product, the operation of certain markets, and the performance of selected marketing functions. Prerequisites: Econ. 14, P.H. 1. Recitation 3 hours. *Professor C. A. Becker*

AGR. EC. 540. THESIS IN AGRICULTURAL ECONOMICS (6).—The preparation of the required thesis for the degree of Master of Science in agricultural economics while in residence at the College.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. EC. 400, 400X. PUBLIC POLICIES IN AGRICULTURE (1-2)
AGR. EC. 404. FARM FINANCE (2) *Professor L. F. Miller*
AGR. EC. 405. STATISTICS APPLIED TO THE RURAL SOCIAL SCIENCES (3) *Professor G. E. Brandow*
AGR. EC. 407. ADVANCED FARM MANAGEMENT (3) *Professor L. F. Miller*
AGR. EC. 420. AGRICULTURAL PRICES (3) *Professor G. E. Brandow*
AGR. EC. 421. LAND ECONOMICS (3) *Professor W. E. Keepper*

AGRICULTURAL EDUCATION

Professor Henry S. Brunner, M.S., Ph.D.
Head of the Department

Agr. Ed. 501v. History of Agricultural Education (1-3).—Development of training for the vocation of agriculture from primitive conditions to the present; emphasis upon the introduction of agricultural instruction into the high school since 1900. Lecture 1 to 3 hours. *Professor W. F. Hall*

Agr. Ed. 502v, 502vX. Teaching Vocational Agriculture (1-3).—Organizing subject matter with respect to its vocational value and methods of presentation. Students may specialize in methods of teaching animal husbandry, horticulture, etc. Lecture and conference 1 to 3 hours.

Agr. Ed. 503v, 503vX. Research in Agricultural Education (1-6 per semester).—Dealing with various phases of such subjects as state teacher training in agricultural education, and measuring results of teaching vocational agriculture. Conferences. *Professor H. S. Brunner and Staff*

Agr. Ed. 504v. Agricultural Education Seminar (1 per semester). *Professor H. S. Brunner and Staff*

Agr. Ed. 506v, 506vX. Problems in County Vocational Supervision (1-3).—To meet the needs of county agricultural supervisors and directors of vocational schools, including such topics as co-operation with county superintendents, vocational supervision, plans of work, community meetings and organizations. Lecture 1 to 3 hours. *Professor W. F. Hall*

Agr. Ed. 508v. State and County Administration and Supervision of Agricultural Education (1-3).—Organization and administration of state, county, township, and district systems of agricultural education, with special reference to vocational work; state and federal legislation; administration and supervision of agricultural education in secondary schools and colleges. Lecture 1 to 3 hours. *Professor H. S. Brunner*

Agr. Ed. 509v, 509vX. Teacher Training in Agricultural Education (1-6).—Problems in agricultural education; construction of college curricula, courses of study, and organization of college departments for the training of agricultural teachers. Lecture 1 to 6 hours. *Professor C. S. Anderson*

Agr. Ed. 520v, 520vX. Scientific Method in the Study of Agricultural Education (1-4).—Methods of procedure in education investigation and experimentation, accompanied by a critical examination of studies made in agricultural education. Lecture 1 to 4 hours. *Professor H. S. Brunner*

Agr. Ed. 521v, 521vX. Scientific Method in the Study of Agricultural Education (1-4).—Continuation of Agr. Ed. 520v; emphasis upon the statistical techniques for students' individual problems. Reports and discussions. Lecture 1 to 4 hours. *Professor W. F. Hall*

Agr. Ed. 522v, 522vX. Field Studies in Agricultural Education (1-4). —The organization and administration of agricultural education in its local bearings; a laboratory course based upon detailed surveys of local school conditions. Lecture 1 to 4 hours. *Professor H. S. Brunner and Staff*

Agr. Ed. 523v, 523vX. Field Studies in Agricultural Education (1-4). *Professor H. S. Brunner and Staff*

AGR. ED. 524v, 524vX. ANNUAL PLAN OF WORK (1-3).—A detailed study of the agricultural education needs of each student's community and the outlining of annual plans of work. Lecture 1 to 3 hours. *Professor C. S. Anderson*

AGR. ED. 525v. MASTER'S THESIS (1-6).—Conferences and assignments in connection with the preparation of the required thesis for the degree of Master of Science in agricultural education. *Professor H. S. Brunner and Staff*

AGR. ED. 530v. AGRICULTURAL COLLEGE TEACHING (3).—Selection and organization of subject matter for specific courses, methods of learning, teaching devices, the technique of teaching, and the measurements of the results of teaching. Lecture 3 hours. *Professor H. S. Brunner and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. ED. 416v. RURAL EDUCATION (3) *Professor W. F. Hall*
AGR. ED. 417v, 417vX. RURAL EDUCATION SURVEY (2) *Professor H. S. Brunner*
AGR. ED. 418v, 418vX. SURVEY OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Professor H. S. Brunner*
AGR. ED. 420v, 420vX. ADVANCED VISUAL AND OTHER SENSORY AIDS IN TEACHING AGRICULTURE (1-6) *Professor D. R. McClay*
AGR. ED. 421v. OBJECTIVES IN RURAL EDUCATION (3) *Professor W. F. Hall*
AGR. ED. 422v, 422vX. SUPERVISION OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Professor D. R. McClay*
AGR. ED. 434v, 434vX. AGRICULTURAL DEVELOPMENTS (1-6) *Professor H. S. Brunner*

AGRICULTURAL ENGINEERING

PROFESSOR RALPH U. BLASINGAME, B.S.
Head of the Department

AGR. ENG. 500. ADVANCED ELECTRO-AGRICULTURE (2-4).—Considerations governing the application and economic use of electrical energy to the home and farm; refrigeration, air conditioning, storage, and processing of agricultural products. A student is given a choice of the type of problem in which he is most interested for his individual study. Written reports.

AGR. ENG. 501. ADVANCED FARM MACHINERY (2-4).—Duty and maintenance cost of farm machinery. Seminar: written reports.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. ENG. 400. AGRICULTURAL ENGINEERING PROBLEMS AND SEMINAR (1-7)
AGR. ENG. 401a,b,c,dS. FARM MECHANICS FOR THE TEACHER OF VOCATIONAL AGRICULTURE (1½-6)
AGR. ENG. 402. FUNCTIONAL DESIGN OF FARM STRUCTURES (3)
AGR. ENG. 405. ADVANCED FARM ELECTRIFICATION (3)
AGR. ENG. 406. ADVANCED DAIRY ENGINEERING (3)

AGRONOMY

Professor Herbert R. Albrecht, M.S., Ph.D.
Head of the Department

Agro. 501. Advanced Soil Fertility (4).—Factors which determine soil fertility; special attention to the diagnoses of soil and plant problems through field appraisal, laboratory analyses, and plant symptoms; the agronomic properties of manures, fertilizers, and soil amendments, the influence of practices upon yield and composition and probable nutritive value of the crops. Prerequisites: Agro. 431, Bot. 406. *Professor F. G. Merkle*

Agro. 503. Agronomy Seminar (1).—A weekly meeting where papers and discussions will be presented by students and staff members. Each student will present a paper on some phase of his major subject.

Agro. 506. Soil Chemistry (4).—Analyses of the important chemical and biochemical reactions occurring in soils, the conditions which control these reactions and their importance in soil genesis and plant growth; laboratory work of the more typical and significant analytical procedures; lectures and reviews of current literature, and practicum. Prerequisites: Agro. 419, Agr. Biochem. 417 or Chem. 20. *Professor J. E. Steckel*

Agro. 507. Soil Physics (4).—Analyses of the important physical and physicochemical properties and reactions occurring in soils, the conditions which control these reactions, and their importance in soil genesis and plant growth; laboratory work in the conduct of the more typical and significant procedures. Lectures, review of current literature, and practicum. Prerequisites: Agro. 419, Agr. Biochem. 417 or Chem. 20, Phys. 215. *Professor R. B. Alderfer*

Agro. 509. Genetics of Crop Plants (3).—The inheritance in crop plants with particular reference to factor interaction, the genetic aspects of linkage and crossing-over, quantitative inheritance, and heterosis. Prerequisite: Bot. 423. *Professor W. M. Myers*

Agro. 510. The Application of Cytogenetics to Plant Breeding (3).—Cytogenetics, including chromosome structure and behavior, chromosome alterations, polyploidy, interspecific hybridization and their applications to plant breeding. Prerequisite: Bot. 505. *Professor W. M. Myers*

Agro. 511. The Breeding of Farm Crops (3).—The application of genetic principles to the improvement of crop plants. Prerequisite: Hort. 7.

Agro. 512. Field Plot Technique (3).—The design and analyses of field experiments. Prerequisites: Math. 8, Com. 90, or Agr. Ec. 505.

Agro. 516. Humus (2).—The origin and chemical nature of soil organic matter, its importance in soil processes, and its decomposition. Prerequisites: Agro. 419, 431. *Professor A. C. Richer*

Agro. 517. Farm Crops Ecology (2).—The ecological factors influencing the distribution and production of field crops. Prerequisites: Math. 8 or Bot. 406, Com. 90. Lecture 2 hours. *Professor L. L. Huber*

AGRO. 520. SPECIAL SOILS PROBLEMS (1-6 per semester).—Provides basic or practical training in soil science in addition to that available in regular course and thesis offerings.

AGRO. 545. THE APPLICATION OF STATISTICS TO FIELD EXPERIMENTS (3).—The use of advanced statistical designs in planning, analyzing, and interpreting field experiments; the application of such phases as factorial designs, confounding, lattice designs, combined experiments, analysis of covariance, correlation and regression. Problems based on these designs are assigned. Prerequisite: Agro. 512. Lecture 3 hours.

AGRO. 550. SPECIAL CROPS PROBLEMS (1-6 per semester).—Provides basic or practical training in crops science in addition to that available in regular course and thesis offerings.

AGRO. 582. SEMINAR IN BREEDING AND GENETICS OF FARM CROPS (1-8 per semester).—Lecture 1 hour.

AGRO. 583S. LABORATORY METHODS IN FIELD CROPS (3).—Prerequisite: Agro. 512.

AGRO. 591. THESIS RESEARCH (1-15 per semester).—Thesis research in the various crops and soils sciences falling within the program of the department: soil fertility, soil chemistry, soil physics, soil survey, soil mineralogy; plant breeding, pasture management, crop production.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGRO. 402. THE NATURE OF SOIL MINERALS (3) *Professor C. D. Jeffries*
AGRO. 416. THE CLASSIFICATION AND MAPPING OF SOILS (4) *Professor H. W. Higbee*
AGRO. 419. SOIL PROPERTIES (5) *Professor F. G. Merkle*
AGRO. 422. SOIL CONSERVATION (3) *Professor R. B. Alderfer*
AGRO. 423. MEADOW AND PASTURE MANAGEMENT (3)
AGRO. 431. SOIL FERTILITY AND MANAGEMENT (3) *Professor F. G. Merkle*
AGRO. 444. FIELD PLOT TECHNIQUE (3)

ANIMAL HUSBANDRY

PROFESSOR FRANKLIN L. BENTLEY, M.S.
Head of the Department

A.H. 501. PEDIGREE STUDY (1-6).—Research work in breed study history, and analytical study of breed pedigrees, and a complete survey of the herd, flock, or stud book. *Professor W. L. Henning*

A.H. 502. RESEARCH IN MEATS (1-6 per semester).—Investigational work pertaining to methods of handling, cutting, and processing meat and meat products; temperatures and their effect on tenderness, rancidity, and length of storage; freezer storage of meat and meat products; curing; current problems of the meat industry. Prerequisite: A.H. 421. *Professor P. T. Ziegler*

A.H. 503. Livestock Management (3).—The handling of purebred herds and flocks; the relation of the livestock breeders to the public and methods of developing purebred herds and flocks through careful breeding.
Professor F. L. Bentley and Staff

A.H. 504. Livestock Health Problems (3).—Problems dealing with the regulations governing the movement of livestock with special reference to control measures applicable to diseases and disease groups common to men and animals. Prerequisites: A.H. 5, 415.

A.H. 505. Advanced Animal Breeding (1-5).—Special problems in animal genetics as applied to breeding and improvement of horses, cattle, sheep, and swine. Prerequisites: A.H. 22, Bot. 22. *Professor W. L. Henning*

A.H. 506. Research in Animal Husbandry (2-10 per semester).—The prosecution of an assigned problem under the guidance of an instructor. Prerequisites: A.H. 415, 421; or 426.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

A.H. 415. Advanced Anatomy and Physiology (3)
A.H. 421. Advanced Meat Studies (3) *Professor P. T. Ziegler*
A.H. 423. Advanced Stock Judging (2) *Professor W. L. Henning*
A.H. 424. Animal Husbandry Survey (1)
Professor F. L. Bentley and Staff
A.H. 426. Livestock Markets and Marketing (3)
Professors F. L. Bentley, W. L. Henning
A.H. 428. Advanced Animal Nutrition (3)
Professor F. L. Bentley and Staff

ANIMAL NUTRITION

Professor Raymond W. Swift, M.S., Ph.D.
Head of the Department

An. Nutr. 500. Research in Animal Nutrition (Credit to be arranged).—Participation in the research program of the Department of Animal Nutrition and independent investigation. The available facilities make it possible to accommodate only a small number of students.

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

An. Nutr. 401. Physiology of Nutrition (3) *Professor Alex Black*
An. Nutr. 402. Physiology of Nutrition (3) *Professor C. E. French*

ARCHITECTURAL ENGINEERING

Consult Professor Louis A. Richardson, M.S.

A.E. 502. Architectual Engineering (3-8).—Advanced structural design in steel and reinforced concrete. Lectures and class criticism. Practicum and seminar. *Professor L. A. Richardson and Staff*

A.E. 503. Architectural Engineering (4-8).—Continuation of A.E. 502 in which problems of wind bracing in tall buildings, rigid frames, and heavy-framed construction are studied. Practicum and seminar. *Professor R. B. Fox*

A.E. 504. Architectural Engineering (4-8).—Statically indeterminate stresses in steel and reinforced concrete buildings; area moment, slope deflection, and moment distribution methods. Recitation and seminar.
Professor L. A. Richardson and Staff

A.E. 505. Architectural Engineering (4-8).—Continuation of A.E. 504. Recitation and seminar. *Professor J. E. Spagnuolo*

A.E. 506. Architectural Engineering Research (1-15).—The presentation of an assigned problem under the guidance of an instructor.
Professors L. A. Richardson, R. B. Fox, J. E. Spagnuolo

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

A.E. 404.	Architectural Engineering (4)	*Professor R. B. Fox*
A.E. 405.	Architectural Engineering (4)	*Professor L. A. Richardson*
A.E. 406.	Architectural Engineering (4)	*Professor R. B. Fox*
A.E. 407.	Architectural Engineering (3)	*Professor L. A. Richardson*
A.E. 410.	Architectural Engineering (3)	*Professor L. A. Richardson*
A.E. 411.	Architectural Engineering (3)	*Professor R. B. Fox*

ARCHITECTURE

Professor Milton S. Osborne, M.S.
Head of the Department

Arch. 501. Architectural Design (4-8).—Problems in advanced planning and design, including study of group composition. Practicum and seminar.
Professor M. S. Osborne and Staff

Arch. 502. Architectural Research (2-12).—The prosecution of assigned problems under the guidance of an instructor.
Professor M. S. Osborne and Staff

Arch. 503. Architectural History Research (3-12).—Original research in architectural history. Seminar and written reports.
Professor M. S. Osborne and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Arch. 406. Advanced Architectural Design (7)
Professor M. S. Osborne and Staff

Arch. 407. Advanced Architectural Design (7)
Professor M. S. Osborne and Staff

Arch. 410. Advanced Architectural Design (2-12)
Professor M. S. Osborne and Staff

Arch. 421. Contemporary Architecture (3)
Professors H. E. Dickson, F. E. Hyslop Jr., P. F. Norton

ART

PROFESSOR MILTON S. OSBORNE, M.S.
Head of the Department of Architecture

(See also courses in Art Education below.)

ART 500. ART RESEARCH (2-6).—The prosecution of assigned problems under the guidance of an instructor. *Professor H. S. Galbraith*

ART 501. ITALIAN PAINTING (2-6).—Investigations in the field of early Italian painting. Seminar, written reports. *Professor H. E. Dickson*

ART 502. MEDIEVAL SCULPTURE (2-6).—Sculpture of Italy and France from the 9th to the 13th centuries. Seminar, written reports.
Professor H. E. Dickson

ART 503. ART HISTORY RESEARCH (3-12).—Original study in some phase of the history of art; investigation of approved subjects. Seminar, written reports, drawing. Prerequisite: a 3-credit 400 course in art history.
Professor H. E. Dickson and Staff

ART 504. SEMINAR: ART LITERATURE AND ICONOGRAPHY (2-6).—Required for degree candidates majoring in art history. Introduction to principles of research in fine arts, designed to familiarize the student with fundamental tools of scholarship in history of art; problems of bibliography and material of iconography; frequent reports on assigned topics provide actual practice in original research. Prerequisite: a minimum of 12 credits in history of art. Conference.
Professor H. E. Dickson and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ART 400S. OIL PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9)
ART 403S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3)
Professor H. E. Dickson
ART 404S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3)
Professor H. E. Dickson
ART 410. WATER-COLOR PAINTING: LANDSCAPE, STILL-LIFE, AND FIGURE (3) *Professor A. W. Case*
ART 490. LIFE DRAWING (3) *Professor A. W. Case*

ART EDUCATION

Consult PROFESSOR VIKTOR LOWENFELD

ART ED. 514. FUNCTIONAL RELATIONSHIPS IN CRAFTS (3).—Relationships of material design and purpose in crafts discussed by means of outstanding products of different materials, periods, and cultures. The student will concentrate on one particular field. Prerequisite: 6 credits in crafts or 3 in design and 3 in advanced crafts. Lecture 2 hours, practicum 2 hours.

ART ED. 534. CREATIVE ART ACTIVITY FOR THE HANDICAPPED (3).—Specific methods for development of creative art activity with the physically, mentally, emo-

tionally, and socially handicapped, and the adjustive effect upon them. Prerequisite: 6 credits in art education or 6 in special education. Lecture 3 hours.

Professor Viktor Lowenfeld

ART ED. 586. RESEARCH IN ART EDUCATION (3-9).—Current experiments in art education; methods for evaluating art activities as they contribute to the growth of the child. Required of students working for a master's degree in art education.

Professor Viktor Lowenfeld

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ART ED. 402. METHODS OF TEACHING DRAWING IN THE GRADES (2-3)
Professor Sybil Emerson

ART ED. 404. METHODS OF GRAPHICS AND ILLUSTRATIONS (3)

ART ED. 414. ADVANCED CRAFTS FOR TEACHERS (3-6)
Professor Sybil Emerson

ART ED. 434. ART APPRECIATION IN THE EDUCATIONAL PROGRAM (2-3)

ART ED. 434b. ART IN THE ELEMENTARY SCHOOL (2-3)
Professor Viktor Lowenfeld

ART ED. 434c. ART IN THE SECONDARY SCHOOL (2-3)
Professor Viktar Lowenfeld

ART ED. 434d. ART SUPERVISION (3) *Professor Viktor Lowenfeld*

ART ED. 486, 486X. CURRENT PROBLEMS IN ART EDUCATION (2-3)
Professor Viktor Lowenfeld

ART ED. 487. MURAL PAINTING IN SCHOOLS (3)
Professor Viktor Lowenfeld

ART ED. 488. ADVANCED MURAL PAINTING IN SCHOOLS (3)
Professor Viktor Lowenfeld

BACTERIOLOGY

PROFESSOR ROBERT W. STONE, Ph.D.
Head of the Department

BACT. 504. DAIRY BACTERIOLOGY PROBLEMS (2-15).—Research on the microorganisms of importance in dairy sanitation, milk production, and manufacture of dairy products. Prerequisite: 12 credits in bacteriology.

BACT. 505. PATHOGENIC BACTERIOLOGY AND IMMUNOLOGY (2-15).—Problems on the morphological, cultural, and immunological characteristics of pathogenic bacteria. Prerequisite: 12 credits in bacteriology.

BACT. 506. RESEARCH (2-15).—Research in bacteriology for students who are doing their major work in this subject for the master's or doctor's degree. Prerequisite: 12 credits in bacteriology.

BACT. 507. BACTERIOLOGICAL SEMINAR (1).—Reports on current fields of research. May be repeated, one additional credit for each semester's work. Prerequisites: Bact. 8, 412. *Professor J. J. Reid*

BACT. 508. PHYSIOLOGY OF BACTERIA (2).—Metabolic processes of bacteria as influenced by their environment; the mechanism of fermentation and respiration of microorganisms. Prerequisites: Bact. 412. Lecture 2 hours.

Professor J. J. Reid

BACT. 508a. LABORATORY IN PHYSIOLOGY OF BACTERIA (2).—Laboratory work to accompany the lectures given in Bact. 508. Prerequisite: Bact. 412. Practicum 6 hours. *Professor J. J. Reid*

BACT. 509. FERMENTATION (2).—The chemical action of microorganisms on their environment; theories of carbohydrate breakdown and the application of these theories to industrial and agricultural fermentations. Prerequisites: Bact. 1, 2, Chem. 31. Lecture 2 hours. *Professor R. W. Stone*

BACT. 510. METHODS AND ANALYSES IN BACTERIAL FERMENTATION (2).—Laboratory procedures and problems in fermentation to accompany Bact. 509. Prerequisites: Bact. 1, 2, Chem. 31. Practicum 6 hours. *Professor J. C. Garey*

BACT. 511. BACTERIOLOGICAL LITERATURE (2-4).—Assigned reading and conferences dealing with a student's research problem. May be taken only in those instances where a student is not scheduling Bact. 504, 505, or 506. Discussion and written reports. Prerequisite: 12 credits in bacteriology.

BACT. 512. LABORATORY IN ADVANCED BACTERIOLOGICAL TECHNIQUES (2-6).—Certain techniques used in research including work with single cell isolation, Warburg apparatus, tissue culture and serology. May be repeated with credit. Prerequisite: 12 credits of bacteriology. Practicum 3 hours per credit.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

BACT. 407. BACTERIOLOGY PROBLEMS (2-9)
BACT. 410. IMMUNOLOGY AND SEROLOGY (4)
BACT. 411. BACTERIOLOGICAL SURVEY (1)
BACT. 412. ADVANCED BACTERIOLOGY (4)
BACT. 413. SOIL BACTERIOLOGY (4)
BACT. 414. FOOD BACTERIOLOGY (4)
BACT. 415. VIROLOGY (4)

BOTANY

PROFESSOR FRANK D. KERN, M.S., Ph.D., D.Sc.
Head of the Department

BOT. 501. THE PHYSIOLOGY OF THE FUNGI (3).—The metabolism of the fungi, general and special nutrition, chemical composition, enzymes, spore germination, toxic and stimulating agencies, growth and tropism, etc. Prerequisites: Bot. 406, 419, and, preferably, Chem. 32. Lectures and practicum.

BOT. 502. THE ASCOMYCETES (3).—The morphology, life histories, taxonomy, and physiology of the ascomycetous fungi. Prerequisite: Bot. 419. Lectures and practicum.

BOT. 503. THE RUSTS AND SMUTS (3).—The morphology, life histories, taxonomy, and phylogeny of the rusts and smuts. Prerequisite: Bot. 419. Lectures and practicum. *Professor F. D. Kern*

BOT. 504. THE HIGHER BASIDIOMYCETES (3).—The structures, habits, taxonomy, and relationships of the various groups of higher basidiomycetes. Prerequisite: Bot. 419. Lectures and practicum.

BOT. 505. CYTOLOGY AND CYTOGENETICS (3).—Components of the protoplast, chromosome structure and cell division; meiosis and syngamy in the life cycle; alter-

nation of chromosome phases in organisms; heteroploidy and chromosome aberrations such as chromosome fragments, inversions, deletions, duplications, transpositions, and translocations and their genetic implications. The role of chromosomes in heredity and breeding. Prerequisites: Bot. 22 or 32, 421. *Professor J. B. Hill*

Bot. 506. Comparative Anatomy of Vascular Plants (3).—The special anatomical features of pteridophytes, gymnosperms, and angiosperms. Prerequisites: Bot. 7, 415, 416. Lectures and practicum. *Professor D. A. Kribs*

Bot. 507. Variation and Selection (3).—Variation and the results of selection in pure lines and clones involving the collection, interpretation, and analysis of data by biometrical means. Prerequisites: Bot. 22 or 32, 423. Lectures and practicum. *Professor J. P. Kelly*

Bot. 508. Problems of Heredity (2-6).—Problems in genetics selected to suit the needs and accomplishments of individual students. Prerequisites: Bot. 22 or 32, 422 or 423. *Professors J. B. Hill, J. P. Kelly*

Bot. 509. The Physiology of Parasitism (3).—The conditions and processes of infection, diseases, and death in plants as caused by parasitic organisms. Prerequisite: Bot. 10, 11, or 419. Lectures and practicum.
Professor H. W. Thurston

Bot. 510. Plant Pathological Problems (3-6).—Special diseases or disease groups, such as bacterial or mosaic diseases, etc. Prerequisite: Bot. 10 or 11. Conferences and practicum. *Professor H. W. Thurston*

Bot. 511. Growth and Movement (2-4).—The physiology of growth with special reference to the influence of external and internal factors upon growth, development, and movement of plants. Prerequisite: Bot. 406. Lecture 2 hours, practicum 4 hours. *Professor H. W. Popp*

Bot. 512. Plant Metabolism (2-4).—The physiological processes involved in the metabolism of plants; alternates with Bot. 511. Prerequisite: Bot. 406. Lecture 2 hours, practicum 4 hours. *Professor H. W. Popp*

Bot. 514. Cytotaxonomy (2).—Relationships within and between the groups of plants as indicated by their cytological features; the origin and relationships of chromosome numbers, homoploidy and heteroploidy, hybridization, apomixis and related phenomena, and the role of these in geographic distribution and speciation in the plant kingdom. Prerequisites: Bot. 414, 505. Lecture 2 hours.
Professor H. A. Wahl

Bot. 515. Disease Resistance and Its Inheritance (2-4).—The nature and etiology of plant diseases; disease resistance as a principle of control; ecology of plant diseases; concepts of disease resistance and escape; stability of disease resistance; economics of control; special problems. Prerequisites: Bot. 22 or 32, 10. Lecture 2 hours, practicum 3 to 6 hours. *Professors C. C. Wernham, W. R. Mills*

Bot. 517. The Fungi Imperfecti (3).—The morphology, life histories, and taxonomy of the fungi imperfecti. Prerequisite: Bot. 419. Lectures and practicum.

Bot. 518. Botanical Research (1-15 per semester).—The prosecution of an assigned problem under the guidance of an instructor.
Professor F. D. Kern and Staff

Bot. 527aS, 527bS. Foundations of Plant Biology (3 per course).—Cellular structure and organization with consideration of the physiological and repro-

ductive processes in so far as these form the basis of plant life. Bot. 527a and 527b will be offered in alternate years. In the former emphasis will be on cellular structure and physiology, in the latter on racial preservation and development and relationship of plant groups. Prerequisite: general biology or general botany courses.
Professor F. D. Kern

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Bot. 406. Plant Physiology (4) *Professor H. W. Popp*
Bot. 407. Plant Anatomy (3) *Professor D. A. Kribs*
Bot. 408. General Plant Pathology (3) *Professor H. W. Thurston*
Bot. 409S. Plant Ecology (3)
Bot. 412. Advanced Forest Pathology (3)
Bot. 414aS. Systematic Botany (3) *Professor H. A. Wahl*
Bot. 414bS. Systematic Botany (3) *Professor H. A. Wahl*
Bot. 415. Morphology of the Algae (3) *Professor J. B. Hill*
Bot. 416. Morphology of the Bryophytes and Pteridophytes (3) *Professor J. B. Hill*
Bot. 418. Botanical Problems (1-6) *Professor F. D. Kern and Staff*
Bot. 419. Mycology (3)
Bot. 420. Morphology of the Seed Plants (3) *Professor A. R. Grove*
Bot. 421. Botanical Technique (3) *Professor J. B. Hill*
Bot. 422. Genetic Phenomena (3) *Professor J. B. Hill*
Bot. 423. Advanced Genetics (2-6) *Professors J. P. Kelly, J. B. Hill*
Bot. 424. Commercial Tropical Woods (3) *Professor D. A. Kribs*
Bot. 432S. Genetics, Eugenics, and Evolution (3)

CERAMICS

Professor Edward C. Henry, M.S., Cer.E., Ph.D.
Chief of the Division

Cer. 500. Ceramics Seminar (1 per semester).—Conferences, reading, and reports. Required of all graduate students in ceramics. Prerequisites: Chem. 41, Phys. 285. Lecture 1 hour. *Professor E. C. Henry and Staff*

Cer. 501. Ceramics Research (1-15 per semester).—Laboratory study on special ceramic problems. Practicum 3 to 45 hours.
Professor E. C. Henry and Staff

Cer. 502. Heat Treatment of Ceramic Materials (2-5).

Cer. 503. Constitution of Glass (2-4).—An advanced course on glass dealing with the latest developments in the structure of viscous liquids and transparent amorphous solids. Prerequisite: Cer. 415. Lecture 2 hours.
Professor Woldemar Weyl

Cer. 504. Research Instruments and Equipment (2).—Application of fundamental laws and principles in research instruments; care, adjustment, and effective use of instruments and equipment (demonstrations). Prerequisite: Cer. 411. Lecture 2 hours. *Professor E. C. Henry and Staff*

CER. 505. GLASS TECHNOLOGY RESEARCH (1-15 per semester).—Laboratory studies on special problems concerning the properties, constitution, and manufacture of glass. Prerequisite: Cer. 415. Practicum 3 to 45 hours.
Professor Woldemar Weyl and Staff

CER. 506. GLASS TECHNOLOGY SEMINAR (1-6).—Group discussion of special advanced topics concerning the properties and manufacture of glass. Prerequisite: Cer. 415. Lecture 1 to 6 hours.

CER. 507. COLORING AND DECOLORIZING GLASS (1).—Physical-chemical considerations of the various coloring oxides; oxidation-reduction equilibria pertaining to coloring and decolorizing of glass. Prerequisite: Cer. 415. Lecture 1 hour.
Professor Woldemar Weyl

CER. 508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2).—Principles of colloidal activity applied to the control of the properties of clay slips, drilling fluids, and similar suspensions; swelling of shales and bentonites; colloidal phenomena associated with the beneficiation and use of industrial minerals. (In co-operation with the Petroleum and Natural Gas staff.) Prerequisite: Chem. 41. Lecture 2 hours. *Professor E. C. Henry*

CER. 509. SILICATE SYSTEMS (3).—Various binary and ternary silicate and oxide systems; reactions in the solid and liquid state; chemical and mineralogical aspects of the manufacture, use, and behavior of refractories; slags as they relate to refractories and to metal melts. Prerequisite: Chem. 41. Lecture 3 hours.

CER. 510. CERAMIC PROBLEMS (1-6 per semester).—Individual study of an advanced nature on a problem in some branch of ceramics, including review of the pertinent literature and a full report of the results of the work. Prerequisite: Cer. 411. Practicum 3 to 18 hours. *Professor E. C. Henry and Staff*

CER. 511. SELECTED TOPICS IN CERAMICS (1-3 per semester).—Intensive group study of special subjects, such as diffusion in solids, viscosity, and kinetics of ceramic processes. Prerequisites: Chem. 41, Phys. 285. Recitation 1 to 3 hours.
Professor E. C. Henry and Staff

CER. 512. SYNTHESIS OF CERAMIC COMPOUNDS (3).—Techniques involved in the synthesis of ceramic compounds and in the measurement of the properties of pure substances and ceramic aggregates; applications of advanced ceramic technology to the control of the phases formed in the commercial production of glass, whitewares, refractories, and cements. Prerequisites: Chem. 41, Cer. 303. Lecture 2 hours, practicum 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CER. 400. SPECIAL TOPICS (1-2)
CER. 401. CERAMIC BODIES AND GLAZES (3) *Professor F. A. Hummel*
CER. 402. PRINCIPLES OF CERAMIC ENGINEERING (3)
Professor E. C. Henry
CER. 403. CERAMIC ENGINEERING PROCESSES AND EQUIPMENT (3)
Professor R. G. Ehman
CER. 404. CERAMICS SEMINAR (1) *Professor E. C. Henry and Staff*
CER. 405. CERAMIC RESEARCH AND DESIGN (3)
Professor E. C. Henry and Staff
CER. 411. THEORY OF CERAMIC PROCESSES (3) *Professor F. R. Matson*
CER. 413. CERAMIC PETROGRAPHY (3) *Professor F. R. Matson*

CER. 415. GLASS AND ENAMELS (3) *Professor R. G. Ehman*
CER. 416. ADVANCED GLASS TECHNOLOGY (3)
Professor Woldemar Weyl, Mr. G. E. Rindone
CER. 420. REFRACTORIES (2) *Mr. N. R. Thielke*

CHEMICAL ENGINEERING

PROFESSOR DONALD S. CRYDER, M.S., D.Sc.
Head of the Department

CHEM. ENG. 500. SEMINAR IN CHEMICAL ENGINEERING (1).—Required of all graduate students.

CHEM. ENG. 510. ADVANCED HEAT TRANSFER I (3).—The physical and chemical factors controlling the rate of heat transfer under conditions of steady flow. Lecture 3 hours. *Professor D. S. Cryder*

CHEM. ENG. 511. ADVANCED HEAT TRANSFER II (3).—Flow of heat under varying temperature conditions. Lecture 3 hours. *Professor D. S. Cryder*

CHEM. ENG. 513. DIFFUSION (2).—The factors controlling diffusional operations such as absorption, extraction, humidification, etc. Lecture 2 hours.
Professor F. L. Carnahan

CHEM. ENG. 515. DISTILLATION (3).—Commercial distillation, equilibrium diagrams, vapor composition, stills and rectifying and stripping columns. Lecture 3 hours. *Professor F. L. Carnahan*

CHEM. ENG. 516. ECONOMIC BALANCE (3).—Problem work on the design of chemical engineering equipment from the economic standpoint. Lecture 3 hours.
Professor M. R. Cannon

CHEM. ENG. 518. CHEMICAL ENGINEERING DESIGN (3).—Complicated examples are discussed and worked out. Several different unit operations will be combined for the design of a complete installation. Lecture 3 hours.
Professor D. S. Cryder

CHEM. ENG. 519. CHEMISTRY OF COMBUSTION (3).—The physical and chemical characteristics of combustion and their influence on plant scale equipment. Lecture 3 hours. *Professor D. S. Cryder*

CHEM. ENG. 524. CHEMICAL ENGINEERING, APPLICATION OF THERMODYNAMICS (3).—Elements of thermochemistry and thermodynamics of greatest importance in chemical engineering. Lecture 3 hours. *Professor M. R. Cannon*

*CHEM. ENG. 580. RESEARCH IN PETROLEUM REFINING (3-15).—Charge will be made for supplies consumed and breakage of equipment.
Professors M. R. Fenske, F. L. Carnahan, Dorothy Quiggle

†CHEM. ENG. 599. RESEARCH IN CHEMICAL ENGINEERING (1-15).—Charge will be made for supplies consumed and breakage of equipment.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CHEM. ENG. 402. CHEMICAL ENGINEERING (4)
Professor F. L. Carnahan
CHEM. ENG. 403. CHEMICAL ENGINEERING (4)
Professor F. L. Carnahan

* Credits to be arranged, 3 to 15 per semester.
† Credits to be arranged, 1 to 15 per semester.

CHEM. ENG. 421. PETROLEUM PRODUCTS (4).—Breakage ticket $3.
Professors F. L. Carnahan, D. S. Cryder, M. R. Cannon

CHEM. ENG. 422. MOTOR FUELS (2) *Professor F. L. Carnahan*

CHEM. ENG. 423. LUBRICANTS (2) *Professor F. L. Carnahan*

CHEM. ENG. 425. STANDARD TESTS OF PETROLEUM AND ITS PRODUCTS (1) —Breakage ticket $2. *Professors F. L. Carnahan, D. S. Cryder, M. R. Cannon*

CHEMISTRY

PROFESSOR GROVER C. CHANDLEE, M.A., M.S., Ph.D., D.Sc.
Head of the Department

CHEM. 500. SEMINAR IN INORGANIC, MICRO, AND TEXTILE CHEMISTRY (1)

CHEM. 501. SEMINAR IN PHYSICAL CHEMISTRY (1)

CHEM. 502. SEMINAR IN ORGANIC CHEMISTRY (1)

CHEM. 515. INORGANIC CHEMISTRY (2).—Adapted to the need of those doing research work in inorganic chemistry. Lecture 2 hours.
Professor A. H. Holtzinger

CHEM. 525. THEORIES UNDERLYING ANALYTICAL CHEMISTRY (2).—Lecture 2 hours. *Professor J. R. Hayes*

CHEM. 531. SPECIAL TOPICS IN ORGANIC CHEMISTRY (3).—May be taken for credit for four successive semesters. Lecture 3 hours.

CHEM. 532. ORGANIC NITROGEN COMPOUNDS (3). The chemistry of the organic compounds containing nitrogen in its various states of combination; esters of oxyacids of nitrogen, amines, amides, iminoesters, hydroxylamines, hydroxamic acids, oxines, nitrosocompounds, diazo and azocompounds, pseudo-bases; stereochemistry of nitrogen, application of modern theories of molecular structure to the constitution of organic nitrogen compounds. Lecture 3 hours. *Professor J. G. Aston*

CHEM. 533. TERPENES (3).—The terpenes and their more important derivatives with special reference to the application of the principles of aliphatic chemistry. Lecture 3 hours.

CHEM. 534. THEORETICAL ORGANIC CHEMISTRY (3).—Application of modern theories of atomic and molecular structure to organic chemistry; resonance in organic compounds; interpretation of physical properties and application to structure proof; theory of rates of chemical reactions as applied to organic chemistry—representative examples; equilibrium properties as a limiting consideration. Lecture 3 hours.
Professor J. G. Aston

CHEM. 535. ORGANIC CHEMISTRY (3).—Adapted to the needs of those doing research work in organic chemistry. Lecture 3 hours. *Professor H. D. Zook*

CHEM. 536. ORGANIC CHEMISTRY (3).—Continuation of Chem. 535. Lecture 3 hours. *Professor H. D. Zook*

CHEM. 538. ORGANIC CHEMISTRY (3).—A survey of organic chemistry arranged primarily for graduate students majoring in fields other than organic chemistry. Lecture 3 hours. *Professor C. I. Noll*

CHEM. 539. STEREOCHEMISTRY (3).—A comprehensive treatment of the principles of stereochemistry as applied to organic compounds. Lecture 3 hours.
Professor T. S. Oakwood

CHEM. 541. PHASE RULE (3).—The phase rule and its applications. Lecture 3 hours. Given 1950-51 and in alternate years thereafter. *Professor A. J. Currier*

CHEM. 542. COLLOIDS (3).—The physics and chemistry of surfaces and their resulting colloid properties. Methods of preparing colloids. Lecture 3 hours.
Professor W. P. Davey

CHEM. 543. RHEOLOGY OF COLLOIDS (3).—Continuation of Chem. 542. Rheology, especially as applied to colloids and similar substances. Lecture 3 hours.
Professor W. P. Davey

CHEM. 544. CHEMICAL THERMODYNAMICS (3).—Development of thermodynamic theory with special reference to common physical changes and chemical reactions. Prerequisite: Chem. 441 or 562. Lecture 3 hours.
Professor J. G. Aston

CHEM. 545. CHEMICAL THERMODYNAMICS AND INTRODUCTORY STATISTICAL MECHANICS (3).—Continuation of Chem. 544 including the calculation of thermodynamic properties from molecular and spectroscopic data. Prerequisite: Chem. 544. Lecture 3 hours. *Professor J. G. Aston*

CHEM. 546. QUANTUM CHEMISTRY (3).—Theory of energy levels in atoms and molecules from the standpoint of wave mechanics with specific emphasis on the portion of the subject applying to common chemical systems. Prerequisite: Chem. 441 or 562. Lecture 3 hours. Given alternate years only. *Professor J. G. Aston*

CHEM. 547. STATISTICAL MECHANICS (3).—The properties of matter at equilibrium developed on the basis of the energy levels of molecules and statistical mechanical theory; calculation of heat capacity, entropy and free energy of gases, crystals, etc. Prerequisite: Chem. 546. Lecture 3 hours. Given alternate years only. *Professor J. G. Aston*

CHEM. 548. CATALYSIS (3).—The theory of catalysis and its application to industry. Lecture 3 hours. Given 1949-50 and in alternate years thereafter.
Professor A. J. Currier

*CHEM. 550. RESEARCH IN THE CHEMISTRY OF TEXTILES (1-15).—Charge will be made for supplies consumed and breakage of equipment.
Professor P. B. Mack

CHEM. 561. CHEMICAL PRINCIPLES (3).—A mathematical treatment of the classical principles of chemistry; their application to problems. Required of all graduate students. Prerequisites: Chem. 41, Math. 11, Phys. 285. A course in organic chemistry is recommended. Lecture 3 hours. *Professor J. G. Aston*

CHEM. 562. CHEMICAL PRINCIPLES (3).—Continuation of Chem. 561. Required of all graduate students. Lecture 3 hours. *Professor J. G. Aston*

CHEM. 563. CHEMICAL KINETICS (3).—The theory and measurement of the rates of chemical reactions; the mechanism of chemical reactions. Lecture 3 hours.
Professor J. H. Simons

CHEM. 564. CHEMICAL KINETICS (3).—Continuation of Chem. 563 but including the theory and measurement of photochemical reactions. Lecture 3 hours.
Professor J. H. Simons

*Credits to be arranged, 1-15 per semester.

CHEM. 565. ATOMIC AND MOLECULAR STRUCTURE (3).—The structure of chemical species and the correlation of experimentally determined properties by structural theory. Lecture 3 hours. *Professor J. H. Simons*

CHEM. 566. ATOMIC AND MOLECULAR STRUCTURE (3).—Continuation of Chem. 565. Lecture 3 hours. *Professor J. H. Simons*

CHEM. 567. ADVANCED THEORETICAL CHEMISTRY (3).—Modern and current theories of the properties of chemical substances and their applications to chemical problems; the construction of chemical theory. Lecture 3 hours. *Professor J. H. Simons*

CHEM. 568. ADVANCED THEORETICAL CHEMISTRY (3).—Continuation of Chem. 567. Lecture 3 hours. *Professor J. H. Simons*

*CHEM. 580. RESEARCH IN PETROLEUM REFINING (1-15).—Charge will be made for supplies consumed and breakage of equipment. *Professor M. R. Fenske*

*CHEM. 599. RESEARCH IN CHEMISTRY (1-15).—Charge will be made for supplies consumed and breakage of equipment.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CHEM. 400. CHEMICAL LITERATURE (1) *Miss M. L. Jackson*

CHEM. 426. ADVANCED QUALITATIVE AND QUANTITATIVE ANALYSIS (5).—Breakage ticket $10. *Professor T. W. Mason*

CHEM. 434. QUANTITATIVE ORGANIC ANALYSIS (3-5).—Breakage ticket $10 for 3 credits, $12 for 4 or 5 credits. *Professor R. W. Higgins*

CHEM. 435. ORGANIC PREPARATIONS AND LABORATORY METHODS (3-5).—Breakage ticket $10 for 3 credits, $12 for 4 or 5 credits. *Professor R. W. Higgins*

CHEM. 436. ORGANIC CHEMISTRY OF NATURAL PRODUCTS (3) *Professor J. G. Aston*

CHEM. 437. QUALITATIVE ORGANIC ANALYSIS (3).—Breakage ticket $4. *Professor J. H. Olewine*

CHEM. 438. INTRODUCTION TO RESEARCH IN ORGANIC CHEMISTRY (2-5).—Breakage ticket $10 for 2 or 3 credits, $12 for 4 or 5 credits. *Professor R. W. Higgins*

CHEM. 440. ADVANCED PHYSICAL CHEMISTRY (3) *Professor A. W. Hutchison*

CHEM. 441. ADVANCED PHYSICAL CHEMISTRY (3) *Professor A. W. Hutchison*

CHEM. 448. COLLOID CHEMISTRY (3).—Breakage ticket $3. *Professor A. W. Hutchison*

CHEM. 453a-h. RECENT ADVANCES IN TEXTILE CHEMISTRY (1-8)

CHEM. 470. CHEMICAL MICROSCOPY (3).—Breakage ticket $2. *Professor M. L. Willard*

CHEM. 471. ADVANCED CHEMICAL MICROSCOPY (3).—Breakage ticket $2. *Professor M. L. Willard*

CHEM. 472. QUANTITATIVE ORGANIC MICROANALYSIS (3).—Breakage ticket $2. *Professor G. H. Fleming*

CHEM. 473. TEXTILE MICROSCOPY (3).—Breakage ticket $2. *Professor M. L. Willard*

* Credits to be arranged, 1-15 per semester.

CHEM. 474. QUANTITATIVE ORGANIC MICROANALYSIS (3).—Breakage ticket $2.
Professor G. H. Fleming

CHEM. 475. INTRODUCTION TO CHEMICAL SPECTROSCOPY (3).—Breakage ticket $2.

CHEM. 476. MICROSCOPIC MICROTECHNIQUE (3).—Breakage ticket $2.
Professor M. L. Willard

CHEM. 477. PAPER MICROSCOPY (3).—Breakage ticket $2.
Professor M. L. Willard

†CHEM. 490. ORGANIC CHEMISTRY (5).—Breakage ticket $4.
Professor J. H. Olewine

†CHEM. 491. ORGANIC CHEMISTRY (5).—Breakage ticket $12.
Professor J. H. Olewine

†CHEM. 492a. ADVANCED GENERAL CHEMISTRY (3).—Breakage ticket $3.
Professor A. J. Currier

†CHEM. 492b. ADVANCED GENERAL CHEMISTRY (3).—Breakage ticket $3.
Professor A. J. Currier

†CHEM. 495. EXPERIMENTAL PROBLEMS IN CHEMISTRY (3 or 6).—Breakage ticket $10 for 3 credits, $12 for 6 credits.
Professor A. J. Currier

†CHEM. 496. GENERAL PHYSICAL CHEMISTRY (3)
Professor A. W. Hutchison

†CHEM. 497. GENERAL PHYSICAL CHEMISTRY (2)
Professor A. W. Hutchison

†CHEM. 498. PHYSICOCHEMICAL MEASUREMENTS (1).—Breakage ticket $6.
Professor A. W. Hutchison

†CHEM. 499. PHYSICOCHEMICAL MEASUREMENTS (1).—Breakage ticket $6.
Professor A. W. Hutchison

CIVIL ENGINEERING

PROFESSOR BENJAMIN A. WHISLER, M.S., Sc.D.
Head of the Department

C.E. 500. SEMINAR IN CIVIL ENGINEERING (1-6).—Reports on researches and special topics. Course may be continued in subsequent semesters.

C.E. 521. TRANSPORT PLANNING AND DESIGN (2-6).—The functional planning and design of transportation facilities. Basic principles and engineering techniques are applied to selected problems in airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

C.E. 522. TRANSPORT OPERATION AND MAINTENANCE (2-6).—Engineering problems in the operation, maintenance, and administration of transportation facilities. Problems are selected from airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

C.E. 540. ADVANCED STRUCTURAL ANALYSIS (2-4).—Geometry of flexure; deflections; analysis of continuous beams, rigid frames, arches; influence lines. Prerequisite: C.E. 40. Lecture 3 hours.

C.E. 541. ADVANCED STRUCTURAL ANALYSIS (2-4).—Truss deflections, analysis of trusses with redundant members, continuous trusses, framed arches; influence lines; secondary stresses; wind stresses; space framework; suspension bridges. Prerequisite: C.E. 40.

† Candidates for the M.Ed. degree.

C.E. 542. Foundations and Soil Mechanics (2-5).—Physical tests, classification, stress distribution, consolidation, shearing resistance, seepage, and permeability of soils, with applications to foundation design, stability of embankment, retaining walls, etc.; foundation construction. Prerequisite: Mchs. 13. Lecture 1 hour minimum, practicum 3 hours minimum.

C.E. 543. Structural Engineering Projects (3-10).—Investigation or design projects in concrete, soil mechanics, photoelasticity, analysis, etc. Prerequisite or concurrent: C.E. 441, 442.

C.E. 544. Advanced Structural Design (2-4).—Plain and reinforced concrete design as applied to buildings, bridges, retaining walls, domes, tanks, and dams; prestressed concrete. Prerequisite: C.E. 42, 442.

C.E. 545. Advanced Structural Design (2-4).—Structural steel design as applied to riveted and welded girders, trusses, rigid frames, wind connections; timber design. Prerequisite: C.E. 41. Lecture 3 hours.

C.E. 546. Structural Data as Basis for Design Specifications (2).—Critical study of experimental data and design specifications for steel and reinforced concrete. Prerequisites: C.E. 41, 42. Lecture 2 hours.

C.E. 550. Engineering Construction (2-4).—Construction methods applied to foundations, buildings, bridges, and other civil engineering construction work. Prerequisites: C.E. 41, 42.

C.E. 560. Theory of Models (2).—The theory of models with special emphasis on laboratory methods in problems in hydraulics and fluid mechanics.

C.E. 561. Hydrologic Investigations (2-4).—Application of hydrologic principles and design techniques to a project selected from such fields as flood control, water power, and water supply. Prerequisite: C.E. 51.

C.E. 562. Technical Fluid Mechanics (2-6).—Analysis of two and three dimensional flow of fluids; analogical methods; flow through porous media; transportation of silt and detritus. Prerequisite: C.E. 61. Prerequisite or concurrent: Math. 431.

C.E. 563. Advanced Independent Studies in Hydraulics or Hydrology (3-6).—Advanced investigation of an approved project in hydraulics or hydrology. Prerequisite: C.E. 462. Lecture 1 hour minimum, practicum 6 hours minimum.

C.E. 564. Hydraulic Engineering Design (2-6).—Design and analysis of selected units of a typical hydraulic engineering project. Prerequisite: C.E. 462.

C.E. 565. River Hydraulics and Flood Control (2-5).—Advanced theory of open channel flow with application to channels; backwater studies; methods of flood control; design problems of structures in flood control districts. Prerequisites: C.E. 51, 462. Lecture 2 hours minimum.

C.E. 571. Water Purification and Softening (2-6).—The principal methods of softening and purifying water for potable and commercial purposes. Prerequisite: C.E. 471.

C.E. 572. Sewage Disposal (2-6).—Methods of disposal of sewage by dilution, tank treatment, oxidation processes, etc. Prerequisite: C.E. 472.

C.E. 573. Sanitary Engineering Projects (3-10).—Investigation of problems in water, sewage, and wastes treatment. Prerequisite: C.E. 472.

C.E. 575. Industrial Waste Treatment and Disposal (2-5).—Industrial waste disposal problems; sanitary analyses and characteristics of industrial wastes; stream pollution and the factors involved in the self-purification of streams. Prerequisite: C.E. 472. Lecture 2 hours minimum, practicum 3 hours minimum.

C.E. 576. Water Treatment Plant Design (3-6).—Design of works connected with the treatment of water for potable, commercial, and industrial purposes. Prerequisite: C.E. 70. Lecture 2 hours minimum, practicum 3 hours minimum.

C.E. 577. Sewage Treatment Plant Design (3-6).—Design of work connected with the treatment and disposal of sewage and/or trade wastes. Prerequisite: C.E. 71. Lecture 2 hours minimum, practicum 3 hours minimum.

In addition to these courses, the following may be taken for gradute credit under the restrictions in force:

C.E. 401a,b,c,d. Civil Engineering Projects (2-12)
C.E. 412. Advanced Photogrammetry (3)
C.E. 421. Highways and Streets (3)
C.E. 422. Railroads (3)
C.E. 441. Statically Indeterminate Structures (3)
C.E. 442. Statically Indeterminate Structures (3)
C.E. 443. Photoelasticity and Model Analysis (3)
C.E. 444. Advanced Soil Mechanics (3)
C.E. 451. Advanced Hydrology (3)
C.E. 462. Advanced Hydraulics (3)
C.E. 471. Municipal and Rural Sanitation (3)
C.E. 472. Sewage and Industrial Wastes Treatment (3)
C.E. 473. Sanitary Engineering Problems (4)
C.E. 474. Advanced Sanitary Engineering Problems (3)
C.E. 481. Municipal Planning and Zoning (3)
C.E. 482. Municipal Engineering and Management (3)

COMMERCE

Professor Carl W. Hasek, M.A., Ph.D.
Head of the Department of Economics

Com. 500. Case Studies in Business Administration (3).—Case studies of business and management policy with respect to procurement, production, selling, finance, accounting, relations with government, labor, and the public. Prerequisite: Com. 401. Lecture 3 hours.

Com. 505. Problems of Corporation Finance (3).—The more important current problems of corporate financial policy, particularly problems of promotion, capitalization, security issue, valuation, administration of income, expansion, reorganization, and government control of policy. Prerequisites: Com. 5, 41. Lecture 3 hours. *Professor G. L. Leffler*

Com. 510. Interbank Relations (3).—Local clearings, out-of-town collections, correspondent banking, branch and group banking, Federal Reserve relations with member and nonmember banks. Prerequisite: Com. 410. Lecture 3 hours. *Professor D. H. McKinley*

COM. 515. TRANSPORTATION RATES AND BUSINESS (3).—Rate making and rate changes and their effects on business location and development. Prerequisite: Com. 15. Lecture 3 hours. *Professor R. H. Waters*

COM. 517. INTERNATIONAL BUSINESS PRACTICES (3).—Practices of exporters and importers dealing in commodities traded in world markets under competition, monopoly, or governmental control. Prerequisite: Com. 17. Lecture 3 hours. *Professor W. M. Hench*

COM. 524. MARKETING POLICIES (3).—Major problems of sales planning, organization, control, and supervision; current trends in merchandising policies of manufacturers; selection and training of salesmen, preparation of selling methods, sales budgets and sales quotas. Prerequisite: Com. 424. Lecture 3 hours. *Professor J. R. Hilgert*

COM. 525. CASE STUDIES IN INSURANCE (3).—An analysis of management's insurance problems, such as the feasibility of self-insurance; proper allocation of insurance premiums and coverage in selected industries, etc. Prerequisite: Com. 25; 33 or 34. Lecture 3 hours. *Professor R. H. Wherry*

COM. 530. C.P.A. LAW REVIEW (3).—Business law affecting accounting; impact of state and federal laws affecting accounting and business practice; review of current legislation. Prerequisite: Com. 430. Lecture 3 hours. *Professor S. C. Tanner*

COM. 548. ACCOUNTING SYSTEMS (3).—Principles of system design including practical application to special businesses, such as financial institutions, department stores, public utilities, etc. Prerequisite: Com. 442. Lecture 3 hours. *Professor C. J. Rowland*

COM. 550. REAL ESTATE PROBLEMS (3).—Analysis of current real estate problems and practices for the broker, the business man, and the property owner; appraisal methods; property management; housing, and the legal, financial, economic, and social aspects of the real estate field. Prerequisite: Com. 50. Lecture 3 hours. *Mr. B. B. Lethbridge*

COM. 560. PROBLEMS OF BUSINESS LOCATION (3).—The economic relationship of such factors as climate, resources, population, transportation and markets, and the location of enterprise. Prerequisite: Com. 60. Lecture 3 hours. *Professor G. F. Mitch*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

COM. 401. PURCHASING (3) *Professor F. A. Babione*
COM. 402. CONTROLLERSHIP (3) *Professor G. A. Tefft*
COM. 405. ANALYSIS OF FINANCIAL STATEMENTS (3) *Professor F. H. Cook*
COM. 410. BANK MANAGEMENT (3) *Professor D. H. McKinley*
COM. 415. REGULATION OF TRANSPORT CARRIERS (3) *Professor R. H. Waters*
COM. 417. FOREIGN MARKETS (3) *Professor W. M. Hench*
COM. 424. MARKETING RESEARCH (3) *Professor J. R. Hilgert*
COM. 425. INSURANCE AGENCY MANAGEMENT (3) *Professor R. H. Wherry*
COM. 428. RETAIL ADVERTISING AND STORE PROMOTION (3) *Professor F. A. Babione*

Com.	430.	Advanced Business Law (3)	*Professor S. C. Tanner*
Com.	442.	Advanced Accounting (3)	*Professor C. J. Rowland*
Com.	444.	Budgetary Control (3)	
Com.	448.	C.P.A. Review Course (3)	*Professor C. J. Rowland*
Com.	450.	Housing and Community Development (3)	*Mr. B. B. Lethbridge*
Com.	460.	American Indusrties (3)	*Professor G. F. Mitch*

DAIRY HUSBANDRY

Professor Donald V. Josephson, M.S., Ph.D.
Head of the Department

D.H. 501. Butter and Cheese (1-6).—The manufacture and handling of butter and cheese. Prerequisites: D.H. 10, 23, Bact. 8, Agr. Biochem. 403.
Professor C. D. Dahle

D.H. 502. Condensed Milk and Milk Powder (1-6).—The condensing and drying of milk. Prerequisites: D.H. 10, 26, Bact. 8, Agr. Biochem. 403.
Professor F. J. Doan

D.H. 503. Public Milk Problems (1-6).—The handling of milk in modern plants. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403.
Professor F. J. Doan

D.H. 504. Ice Cream Manufacture (1-6).—The manufacture of ice cream, ices, and other frozen milk products. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403. *Professor C. D. Dahle*

D.H. 505. Dairy Plant Economics (1-6).—The economic factors involved in creamery operation and management. Prerequistes: D.H. 7, 11.
Professor C. D. Dahle

D.H. 506. Dairy Cattle Breeding (1-6).—The improvement of dairy cattle, including methods of sire evaluation, systems of breeding, and the development of breeding programs. Prerequisite: D.H. 30. *Professor J. O. Almquist*

D.H. 507. Dairy Cattle Management (1-6).—The management of dairy cattle. Prerequisite: D.H. 27. *Professor A. L. Beam and Staff*

D.H. 508. Dairy Seminar (1-6).—The preparation and presentation of a paper on an assigned subject. *Professor D. V. Josephson and Staff*

D.H. 509. Testing Dairy Products (1-6).—The constituents of dairy products. Prerequisites: D.H. 10, 11, Bact. 8, Agr. Biochem. 403.
Professor W. D. Swope

D.H. 510. Dairy Cattle Feeding (1-6).—The application of fundamental research in animal nutrition to the feeding of dairy cattle. Prerequisites: D.H. 1, 29. *Professors A. L. Beam, P. S. Williams*

D.H. 511. Dairy Cattle Nutrition (1-6).—The nutritional requirements of dairy cattle. Prerequisites: An. Nutr. 401, 402.
Professor C. B. Knodt and Staff

D.H. 512. Advanced Studies in Milk Secretion (1-6).—The physiology of milk secretion. Prerequisite: D.H. 427. *Professor C. B. Knodt*

D.H. 513. Dairy Cattle Selection (1-6).—Breed history, pedigrees, selection and judging of dairy cattle. Prerequisites: D.H. 1, 30.
Professor C. B. Knodt and Staff

D.H. 514. Advanced Reproductive and Endocrine Physiology (2-3).—The physiology of reproduction and endocrine physiology of mammals. Prerequisites: A.H. 415, D.H. 431. Given in alternate years.
Professor J. O. Almquist

D.H. 515. Advanced Physiology of Reproduction in Farm Animals (1-6).—The reproduction of farm animals. Prerequisite: D.H. 514.
Professor J. O. Almquist

D.H. 516. Artificial Breeding of Farm Animals (1-6).—Prerequisite: D.H. 431. *Professor J. O. Almquist*

D.H. 517. Dairy Husbandry Literature (1-6).—The review and reporting of dairy literature. *Professor D. V. Josephson and Staff*

D.H. 518. Thesis (1-15) *Professor D. V. Josephson and Staff*

D.H. 519. Research in Dairy Production (1-15 per semester)
Professor D. V. Josephson and Staff

D.H. 520. Research in Dairy Manufacturing (1-15 per semester)
Professor D. V. Josephson and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

D.H. 418. Dairy Survey (1) *Professor D. V. Josephson*
D.H. 421. Dairy Manufacturing Problems (1-6)
Professors C. D. Dahle, F. J. Doan, and Staff
D.H. 427. Milk Secretion (3) *Professor C. B. Knodt*
D.H. 428. Dairy Production Problems (1-3)
Professor A. L. Beam and Staff
D.H. 429. Testing Dairy Products (1-6)
Professor W. D. Swope and Staff
D.H. 430. Technical Control of Dairy Products (4)
Messrs. N. A. Perry, G. H. Watrous Jr.
D.H. 431. Physiology of Reproduction in Farm Animals (3)
Professor J. O. Almquist

DRAMATICS

Consult Professor Arthur C. Cloetingh, M.A.

Dram. 501. Problems of Production (3-6).—Seminar in problems of production with particular stress on direction. Students will direct plays under staff supervision. *Professor R. D. Reifsneider*

Dram. 502. Graduate Seminar in the Technical Problems of Dramatic Production (3).—Prerequisite: Dram. 11. *Professor A. C. Cloetingh*

Dram. 503. Art of Dramatic Lighting (3).—Graduate seminar in stage lighting; advanced study in the theory of lighting as used for dramatic effectiveness. Practical work required of each student. Prerequisite: Dram. 12.
Professor W. S. Smith

DRAM. 504. GRADUATE SEMINAR IN STYLES OF ACTING AND DIRECTING (3).—Practical work required of each student. *Professor A. C. Cloetingh*

DRAM. 506. EVALUATION AND APPRECIATION OF MODERN DRAMATIC ENTERTAINMENT (3).—Prerequisites: Dram. 1, 61. *Professor A. C. Cloetingh*

DRAM. 507. SEMINAR IN FUNDAMENTAL THEORIES OF THEATER AND DRAMA (3-6).—Prerequisite: graduate standing. Recitation 3 hours. *Professor A. C. Cloetingh*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

DRAM. 403. ADVANCED MAKE-UP (1) *Professor W. S. Smith*
DRAM. 412. DRAMATIC DESIGN (3) *Professor Dorothy Scott*
DRAM. 421. ADVANCED PLAYWRITING (3) *Professor W. S. Smith*
DRAM. 431. HISTORY OF THE THEATER (3) *Professor W. S. Smith*
DRAM. 441. EDUCATIONAL DRAMATICS (CHILDREN'S ENTERTAINMENT) (3)
DRAM. 442S. EDUCATIONAL DRAMATICS (3)
DRAM. 443S. EDUCATIONAL DRAMATICS (ADVANCED MARIONETTES) (3)
DRAM. 451. DIRECTING (3) *Professor R. D. Reifsneider*
DRAM. 470. DRAMATICS IN THE SCHOOLS (3) *Professor W. S. Smith*
DRAM. 480. RADIO DRAMA (3)
DRAM. 481. ADVANCED RADIO DRAMA (3)

ECONOMICS

PROFESSOR CARL W. HASEK, M.A., Ph.D.
Head of the Department

ECON. 500. ECONOMICS SEMINAR (3-6).—Seminar 3 hours.
ECON. 501. ECONOMICS SEMINAR (3-6).—Seminar 3 hours.
ECON. 502. VALUATION OF PUBLIC UTILITIES (3) *Professor F. H. Cook*
ECON. 503. PRICES AND PROFITS (3)
ECON. 504. PROBLEMS OF CORPORATION FINANCE (3) *Professor G. L. Leffler*
ECON. 505. TRANSPORTATION SEMINAR (3).—Prerequisite: Com. 15. Seminar 3 hours. *Professor R. H. Waters*
ECON. 507. INTERNATIONAL ECONOMIC RELATIONS (3) *Professor W. M. Hench*
ECON. 508. BANKING PROBLEMS (3) *Professor D. H. McKinley*
ECON. 509. TAXATION PROBLEMS (3) *Professor R. S. Stout*
ECON. 510. DEMAND ANALYSIS (3)
ECON. 511. ECONOMIC BASES FOR CONTROL OF INDUSTRIAL DISPUTES (3). Prerequisites: Econ. 1 or 14, 15. Lecture 3 hours. *Professor E. A. Myers*
ECON. 512. WAGES (3) *Professor D. S. Brown*
ECON. 515. LABOR SEMINAR (3) *Professor A. H. Reede*
ECON. 520. ADVANCED ECONOMIC STATISTICS (3).—Prerequisites: 6 credits in economics and 3 in statistics. *Professor R. B. Saylor*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ECON. 400. HISTORY OF ECNOMIC THOUGHT (3) *Professor C. W. Hasek*
ECON. 401. RECENT ECONOMIC THOUGHT (3) *Professor C. W. Hasek*

Econ.	402.	Advanced Economic Theory (3)	
Econ.	403.	Advanced Economic Theory (3)	
Econ.	410.	Economics of Consumption (3)	*Professor S. Keyes*
Econ.	411.	Economics of Labor Relations (3)	*Professor E. A. Myers*
Econ.	412.	Economics of Collective Bargaining (3)	*Professor A. S. Luchek*
Econ.	414.	Economics of Labor Legislation (3)	*Professor E. A. Myers*
Econ.	415.	Social Insurance (3)	*Professor A. H. Reede*
Econ.	416.	Management of Labor Relations (3)	*Professor D. S. Brown*
Econ.	417.	International Commercial Policies (3)	*Professor W. M. Hench*
Econ.	418.	Elementary Wage Theory (3)	*Professor D. S. Brown*
Econ.	420.	Investments (3)	*Professor G. F. Mitch*
Econ.	421.	Central Banking Systems (3)	*Professor D. H. McKinley*
Econ.	422.	Investment Banking (3)	*Professor G. L. Leffler*
Econ.	423.	Pennsylvania Local Finance (3)	*Professor R. S. Stout*
Econ.	424.	Pennsylvania State Finance (3)	*Professor R. S. Stout*
Econ.	425.	The Money Market (3)	*Professor D. H. McKinley*
Econ.	430.	National Planning (3)	*Professor S. Keyes*
Econ.	435.	Problems of Federal Finance (3)	*Professor R. S. Stout*
Econ.	450.	The Business Cycle (3)	*Professor C. W. Hasek*
Econ.	490.	Economic Statistics (3)	*Professor R. B. Saylor*

EDUCATION

Professor P. C. Weaver, M.Ed., Ph.D.
Acting Head of the Department

Ed. 501. Introduction to the Advanced Study of Education (1).—Methods of scientific research; criticism of studies in the light of the canons of scientific method; types of research, the nature and standards of these for postgraduate degrees.

Ed. 515. Comparative Education (3).—Education in foreign countries, especially England, France, Germany, Italy, and Russia in contrast to American education; special investigations of recent educational progress of such nations as China, Japan, Denmark, Sweden, Switzerland, Poland, Greece, Spain, and Mexico; the cultural quality and political status of some South American countries. Prerequisite: Psy. 14. Lecture 3 hours. *Professor C. D. Champlin*

Ed. 517. Evolution of Educational Thought (2-3).—Educational thought from early Greeks to the present; as an outcome of social, economic, religious, philosophical, and political theory and practice. Prerequisite: graduate maturity. Lecture 2 or 3 hours. *Professor C. D. Champlin*

Ed. 522. Production of Educational Moving Pictures (1-3).—A laboratory course arranged co-operatively with the College Motion Picture and Recording Studio. The student participates in the production of educational films. Prerequisites: Ed. 424, 487 (Unit B). Conference 1 hour, alternate weeks by appointment. Practicum 1 to 5 hours. *Professor A. W. VanderMeer*

ED. 523. LABORATORY IN ORGANIZATIONAL ASPECTS OF MATERIALS OF INSTRUCTION (1-3).—Experience in organizing, storing, and maintaining verbal and nonverbal instructional materials in a manner that will facilitate their curricular use. Facilities of the Instructional Materials Center and the Audio-Visual Library will be used. Prerequisites: Ed. 424, 585. Conference 1 hour, alternate weeks by appointment. Practicum 1 to 5 hours. *Professor A. W. VanderMeer*

ED. 524. SEMINAR IN CURRICULUM MATERIALS AND THEIR UTILIZATION (3).—Techniques of communication of ideas through various teaching devices commonly used in public schools; relation of specific materials and techniques of presentation to types of learning; organization of curriculum materials in relation to the learning process and individual differences in students. Prerequisites: Ed. 424, 585, 6 hours of educational psychology. Lecture 3 hours.
Professor A. W. VanderMeer

ED. 525. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3).—Aims to develop an understanding of the science supporting dynamic instruction; basic principles of teaching developed inductively; careful analysis of modern procedures such as the unit and unit assignment, individual instruction, project method, problem method, laboratory study plan, ability grouping, and the activity concept. Prerequisite: 12 semester hours of undergraduate work in education.
Professor F. A. Butler

ED. 527. PROBLEMS IN THE EDUCATION OF THE MENTALLY RETARDED (1-4).—Intensive study of existing educational procedures; analysis of life needs of the mentally retarded; experimentation in construction of curriculum, instructional materials, long-term planning, and follow-up programs. Prerequisites: Ed. 426 and teaching experience, Ed. 427 or 583, Unit P. Lecture 1 to 4 hours.

ED. 532. SUPERVISION OF STUDENT TEACHERS (3).—Practical problems of organizing, administering, and teaching courses in observation and practice teaching. Prerequisite: experience in teaching, and 18 credits in education, including at least 5 credits in methods. Lecture 3 hours. *Professor F. E. Taylor*

ED. 534a. READING CLINIC PRACTICE: ANALYSIS OF READING DISABILITIES (1-9).—A laboratory course in the reading analysis division consisting of analysis of extreme reading disabilities, case typing, prognosis, and recommended remedial procedures; experience in techniques, procedures, and the preparation of case reports; attendance at scheduled staff meetings required; individual reading clinic practice under supervision arranged by appointment. Prerequisite: Ed. 432g or Psy. 550.

ED. 534b. READING CLINIC PRACTICE: REMEDIAL PROCEDURES (1-9).—Practicum in special classes for reading disabilities; corrective and remedial procedures demonstrated; experience in dealing with specific procedures for the correction of various types of reading disabilities. Attendance at scheduled staff meetings required. Individual reading clinic practice under supervision arranged by appointment. Prerequisite: Ed. 432g or 534a.

ED. 535. SEMINAR ON READING INSTRUCTION (2-12).—Designed to appraise significant researches and to outline procedures and materials for research. Reading readiness, word perception, basic reading skills, vocabulary development, sociology of reading, readability, reading interests, eye movements, hygiene of reading, differentiated instruction, factors in reading ability, study, language development, and dyslexia. Prerequisite: Ed. 432b or 432c.

ED. 536. READING CLINIC RESEARCH (1-15).—Prerequisites: Ed. 432b; or 432c, 432g.

ED. 540. PROBLEMS OF ELEMENTARY EDUCATION (2-3).—Desirable outcomes of elementary education; characteristics of children; individual differences and homogeneous groupings; influence of scientific studies of education upon materials and methods. Prerequisite: 12 credits in education and psychology, including 6 credits in elementary education. *Professor Paul Bixby*

ED. 546. ELEMENTARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3). *Professor Paul Bixby*

ED. 548. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3). —Principles underlying curriclum construction; the organization by the student of a curriculum for an elementary school, showing the adaptation of the best educational theory and practice to meet the needs of a specific community. Prerequisite: Ed. 31 or teaching experience. Lecture 2 or 3 hours. *Professor Paul Bixby*

ED. 550. PROBLEMS IN MODERN SECONDARY EDUCATION (1-4).—The historical, psychological, social, and economic factors influencing secondary education; emphasis upon the emerging philosophy, curricula, objectives, issues, functions, and procedures. Required as basic course of all graduate students in secondary education. Prerequisite: Ed. 450 or secondary school teaching. *Professor F. A. Butler*

ED. 551. SEMINAR IN CONTEMPORARY ISSUES IN SECONDARY EDUCATION (2-9). *Unit A.—The Secondary School Curriculum* (2-3).—Principles and philosophy of curriculum construction. Each student will work out an individual problem in the secondary school curriculum. Prerequisites: 12 credits in education and psychology, and teaching experience. *Professor J. H. Moyer*

Unit B. Laboratory Studies in Application of Educational Method (2-3).—Analysis and application of outstanding studies in secondary education. Open to experienced high school teachers interested in integrating the results of educational research with public school procedures. Prerequisites: 12 credits in education and psychology, and teaching experience.

Unit C. Organization and Administration of Secondary Education (2-3).—Problems related to the reorganization of secondary education, with particular reference to the junior high school; designed for teachers and principals who want to study the philosophy, organization, and teaching problems of the junior high school. Prerequisites: 12 credits in education and psychology, and teaching experience.

ED. 556. THE SECONDARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3).—Improvement of instruction on the secondary school level; selection of teachers; improvement of teachers in service; evaluation of teaching procedures; methods of supervision; selection and use of textbooks; evaluation of supervisory programs and other topics. Prerequisite: three years' teaching experience. Lecture 2 or 3 hours. *Professor M. J. Wyland*

ED. 561. THE JUNIOR COLLEGE (2-3).—The relation of junior colleges to public education programs; history, philosophy, functions, organization, administration, maintenance, location, student and teaching personnel; curricular and extracurricular activities; standards. Prerequisite: any one of the following—Ed. 480, 550, 556, 567, or educational administrative experience. *Professor P. C. Weaver*

ED. 562. CURRICULA AND INSTRUCTIONAL PROCEDURES IN JUNIOR COLLEGES (2-3).—Course offerings and organization of curricula for postsecondary and junior college students; instructional materials and procedures; the place and function of

guidance; extracurricular activities; student personnel problems; and the evaluation of results. Prerequisite: Ed. 480, 556, 567, or educational administrative experience. Lecture 2 or 3 hours. *Professor P. C. Weaver*

Ed. 563. The Professional Education of Teachers (3).—The development and present status of teacher education; objectives and standards; selection and guidance of students; personnel problems in relation to staff; principles and trends in organization of program of study and curricula; administration and organization; financial management; evaluation of achievement; research; stimulation of professional improvement of in-service teachers. Prerequisites: 6 credits in advanced courses in education and a course in educational psychology. Lecture 3 hours.

Ed. 567. Problems in Collegiate Education (2-3).—Designed to give a better understanding of relationships between higher education and the educational program as a whole. Historical developments of higher education; the place of the state and local governments; the functions of various types of higher institutions; their government; internal organization and administration; financial support; foundations; and accrediting agencies. Prerequisite: Psy. 14. Lecture 2 or 3 hours. *Professor P. C. Weaver*

Ed. 568. Problems in Collegiate Education (2-3).—Aims and objectives of higher institutions; principles and current trends in curriculum construction; general education; selection of students; guidance and personnel; student activities, and measurement of results. Prerequisite: Psy. 14. *Professor P. C. Weaver*

Ed. 569. Seminar in Collegiate Education (1-6).—Special topics in higher education. Prerequisite: Ed. 567. Lecture 1 to 6 hours. *Professor P. C. Weaver*

Ed. 574. Advanced Educational Statistics (2-4).—Derivation of the formulae used in elementary statistics, practice in evaluating the uses, statistical procedures, and interpretations of the result; partial and multiple correlation, special formulae for correlation; transmutation of scores; weighting elements of a battery of tests; curve fitting, particularly as related to the normality of a distribution and to the growth curve. Prerequisite: at least a 2-credit course in elementary statistics. Lecture 2 to 4 hours.

Ed. 575. Administration and Supervision in Business Education (3).—The work of administrators, directors, supervisors, department heads, and others responsible for improvement of instruction and development of sound business education programs; importance of close co-operation between school and business; use of vocational testing, job analysis, surveys, and research in improving programs of business education. Prerequisite: 6 credits in secondary education. Lecture 3 hours. *Professor James Gemmell*

Ed. 576. Introduction to Research in Business Education (3).—Designed to acquaint students with methods of reseach in business education. Opportunity to compile useful annotated bibliographies on current problems in business education; practice in analysis and evaluation of significant researches and current periodical articles on business education. Lecture 3 hours. *Professor James Gemmell*

Ed. 577. Evaluation of Research and Empirical Literature in Business Education (3).—Application of evaluation methods to current literature in business education; special attention to research studies. Prerequisite: Ed. 576. Lecture 3 hours. *Professor James Gemmell*

Ed. 578. Seminar in Business Education (3).—Intended for graduate students preparing theses or final documents, or for those working on special studies in business education. Prerequisite: Ed. 577. Lecture 3 hours.

Professor James Gemmell

Ed. 580. Seminar in School Administration (1-6).—Deals with efficiency in supervision, methods of diagnosis and evaluation of teaching and learning procedure, improving instruction, maintaining teacher morale, and stimulating co-operative work. For superintendents, principals, department heads, advisers, and others with administrative or supervisory duties. Prerequisites: Ed. 25, 31, 480, or teaching experience. Recitation 1 to 6 hours.

Ed. 582. Educational Survey Techniques (2-3).—The progress and results in local school systems; undertakes to study how to make school surveys. A major project for Doctor of Education candidates. Students will be expected to make a survey in the local school system during the following year.

Professor W. S. Vincent

Ed. 583. Problems in Administration and Supervision (2-19).

Unit A. The Educational Plant (2) *Professor W. S. Vincent*

Unit B. Public Relations for School Administrators (2-3) *Professor W. S. Vincent*

Unit C. Public School Finance (2-3) *Professor W. S. Vincent*

Unit I. Administration of Adult Education in the Public Schools (2) *Professor W. S. Vincent*

Unit M. Legal Aspects of School Administration (2) *Professor W. S. Vincent*

Unit P. The Administration of Public School Education for Atypical Children (2) *Professor M. A. Neuber*

Unit Q. Dynamic Factors in School Administration (2) *Professor W. S. Vincent*

Unit R. Public School Business Administration (2-3) *Professor W. S. Vincent*

Ed. 585. Curriculum Construction (2-3).—Governing principles in curriculum construction and the educational value of each; analysis of subject matter and organization of such material into units of instruction; the most effective type of curriculum and the function of the administrator, supervisor, and teacher in its construction.

Ed. 586. Principles of School Supervision (2-3).—Principles and techniques of supervision; organization of supervision; planning the supervisory program; developing standards of teaching and learning; improvement of learning through tests, teacher rating, and other devices. For superintendents, supervising principals, elementary and high school principals, supervisors, and others preparing for such positions. Prerequisites: 18 credits in education and 3 years' teaching experience. Lecture 2 or 3 hours.

Ed. 587. The Secondary School Principal as Administrator (2-4).—The work of the administrator of a junior or senior high school; problems of schedule making, teachers' meetings, curriculum making and revision, and organization of extracurricular and guidance programs. Prerequisite: teaching experience.

Professor M. J. Wyland

ED. 589. THE ELEMENTARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-3).—Pupil and teacher personnel management; course of study; programs and schedules; articulation; health; extracurricular programs; textbook supply and equipment management; care and use of buildings and grounds; reports; community relations. Prerequisite: Ed. 442. Lecture 2 or 3 hours. *Professor Paul Bixby*

ED. 590. PHILOSOPHY OF EDUCATION (2-4).—Fundamental principles of education; scientific sanctions of progressive instructional practices and professional experiences as bases for the formulation of the educational creed. Prerequisite: 18 credits in education. Lecture 2 to 4 hours. *Professor C. D. Champlin*

ED. 594. SEMINAR IN EDUCATION (1-6).—Conferences and discussions designed to meet the need for special study of particular fields in education. Prerequisite: requirements for graduation in education.

ED. 595. EDUCATIONAL RESEARCH (1-15).—An inductive research from primary sources expected to maintain standards sufficiently high to warrant publication of the findings. Prerequisite: at least 6 hours of graduate study in education, including some work in statistics.

ED. 597S. WORKSHOP IN CURRENT EDUCATIONAL PROBLEMS (1-6).—Seminar for administrators, supervisors, experienced elementary and secondary teachers, and guidance workers; administrative, supervisory, and instructional problems involved in an emerging educational program. Units determined by current educational needs. Prerequisite: 12 credits in graduate work in education. Lecture 1 to 6 hours. *Professor M. J. Wyland and Staff*

ED. 599. THESIS (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ED. 412, 412X. HISTORY OF MODERN EUROPEAN EDUCATION (3) *Professor C. D. Champlin*

ED. 413, 413X. HISTORY OF EDUCATION IN THE UNITED STATES (2-3) *Professor C. D. Champlin*

ED. 414. HISTORY OF EDUCATION IN PENNSYLVANIA (2-3) *Professor C. D. Champlin*

ED. 415S, 415X. MODERN TENDENCIES IN AMERICAN EDUCATION (1-6)

ED. 416X. SOCIAL EDUCATION (3)

ED. 421X. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3)

ED. 424, 424X. VISUAL AND OTHER SENSORY AIDS FOR TEACHERS (1-3) *Professor A. W. VanderMeer*

ED. 425S, 425X. THE SCIENTIFIC DIRECTION OF LEARNING ACTIVITIES (2-4) *Mr. S. D. Melville*

ED. 426, 426X. EDUCATION OF EXCEPTIONAL CHILDREN (2-3) *Professor M. A. Neuber*

ED. 427. EDUCATION OF THE MENTALLY RETARDED (2-3) *Professor M. A. Neuber*

ED. 428, 428X. UNITS A, B, C. ADULT EDUCATION: ORGANIZATION, TYPES, AND METHODS (1-3) *Professor C. D. Champlin*

ED. 429, 429X. THE GIFTED CHILD (1-3) *Professor M. A. Neuber*

ED. 432b, 432bX. THE ELEMENTARY SCHOOL READING PROGRAM (2-3)

ED. 432c, 432cX. READING PROBLEMS IN THE SECONDARY SCHOOL (2-3)

ED. 432d, 432dX. SPECIAL PROBLEMS IN THE TEACHING OF ELEMENTARY SCHOOL ENGLISH (2-3)

ED. 432eX. CHORAL SPEAKING (3)
ED. 432f, 432fX. TEACHING SECONDARY SCHOOL ENGLISH (2-3)
ED. 432g, 432gX. READING DISABILITIES (2-3) *Mr. S. D. Melville*
ED. 432h, 432hX. TECHNIQUES IN REMEDIAL READING (2-6) *Mr. S. D. Melville*
ED. 433f, 433fX. TEACHING CHILDREN'S LITERATURE (2-3)
ED. 433h, 433hX. PROBLEMS OF ELEMENTARY SCHOOL ARITHMETIC (2-3) *Professor M. A. Neuber*
ED. 433n, 433nX. TEACHING SOCIAL STUDIES IN THE ELEMENTARY GRADES (2-3) *Professor F. E. Taylor*
ED. 433w, 433wX. TEACHING SOCIAL STUDIES IN THE HIGH SCHOOL (2-3) *Professor A. W. VanderMeer*
ED. 433y, 433yX. TEACHING MATHEMATICS IN THE SECONDARY SCHOOL (3)
ED. 435X. EDUCATION FOR CITIZENSHIP (2-3) *Professor C. D. Champlin*
ED. 438, 438X. TEACHING SCIENCE IN SECONDARY SCHOOLS (2-3) *Professor G. J. Free*
ED. 438e, 438eX. TEACHING SCIENCE IN THE ELEMENTARY SCHOOL (1-3) *Professor G. J. Free*
ED. 439, 439X. TEACHING TRAFFIC SAFETY AND AUTOMOBILE OPERATION (1-3) *Professor A. E. Neyhart, Mr. Joseph Intorre*
ED. 441X. PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS (2-3) *Professor Paul Bixby*
ED. 442, 442X. ELEMENTARY EDUCATION (2-3) *Professor Paul Bixby*
ED. 448X. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3) *Professor Paul Bixby*
ED. 449aS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE ELEMENTARY SCHOOL (3) *Professor G. J. Free*
ED. 449bS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE SECONDARY SCHOOL (3) *Professor G. J. Free*
ED. 450X. SECONDARY EDUCATION (2-3) *Professor F. A. Butler*
ED. 451X. SPECIAL PROBLEMS OF THE HIGH SCHOOL TEACHER (2-3)
ED. 453, 453X. EDUCATIONAL AND VOCATIONAL GUIDANCE (2-3) *Professor M. J. Wyland*
ED. 454, 454X. EXTRACURRICULAR ACTIVITIES IN THE JUNIOR AND SENIOR HIGH SCHOOL (2-3) *Professor J. H. Moyer*
ED. 456, 456X. PRINCIPLES AND PROBLEMS IN BUSINESS EDUCATION (1-3) *Professor James Gemmell*
ED. 459, 459X. IMPROVEMENT OF INSTRUCTION IN BUSINESS SKILL SUBJECTS (1-3) *Professor James Gemmell*
ED. 460. CURRICULA IN BUSINESS EDUCATION (3) *Professor James Gemmell*
ED. 461. IMPROVEMENT OF INSTRUCTION IN BASIC BUSINESS SUBJECTS (3) *Professor James Gemmell*
ED. 462. TEACHING SHORTHAND AND TYPEWRITING (3) *Professor James Gemmell*
ED. 463. BOOKKEEPING FOR TEACHERS (3) *Professor James Gemmell*
ED. 466. TEACHING OF OFFICE PRACTICE (3) *Professor James Gemmell*
ED. 467. TEACHING OF SHORTHAND (2) *Professor James Gemmell*
ED. 468. TEACHING OF TYPEWRITING (2) *Professor James Gemmell*

*Ed. 470, 470X. Educational Measurements (2-3)
Ed. 474, 474X. Teaching of Occupations (2-3)
Ed. 480, 480X. Educational Administration (2-3)
Professor W. S. Vincent
Ed. 482X. Supervision and Improvement of Instruction (2-3)
Ed. 485X. Curriculum Construction (2-3)
Ed. 487, 487X. Problems in Visual and Other Sensory Aids in Education, Unit A (1-3), Unit B (1-2), Unit C (1-2), Unit D (1-2)
Professor A. W. VanderMeer
Ed. 490X. Philosophy of Education (3) *Professor C. D. Champlin*
Ed. 493, 493X. Character Education and Guidance (2-3)
Professor C. D. Champlin
Ed. 494. Religious Education (2-3)
Ed. 497S, 497X. Workshop in Selected Studies in the Field of Elementary and Secondary Education (1-6)
Professor M. J. Wyland and Staff
Ed. 499, 499X. Problems of Special Education (3)
Professor M. A. Neuber

ELECTRICAL ENGINEERING

Professor Eric A. Walker, M.S., Sc.D.
Head of the Department

E.E. 520. Seminar (1).—Required of all graduate students in electrical engineering. Conferences, reading, and presentation of technical papers.

E.E. 521a,b,c,d. Alternating-Current Theory (2-12).—Special problems in alternating-current theory and the application of these problems to alternating-current circuits or machinery at any frequencies. Lecture and investigations 2 to 12 hours.

E.E. 522. Power Generation (3).—Problems of the generating station in the electrical power system including economic and technical considerations of station location, operation, and control; selection and layout of equipment. Lecture 3 hours.
Professor A. P. Powell

E.E. 523. Transients in Linear Systems (3).—Transient response of linear electric circuits and electromechanical systems including the application of operational methods of analysis to electrical and electromechanical problems. Prerequisite: E.E. 423. Lecture 3 hours. *Professor C. B. Holt*

E.E. 524. Engineering Electronics (3).—Special problems dealing with the design and application of electronic devices and systems; emphasis upon individual projects closely related to other phases of the student's graduate program. Lecture 2 hours, practicum 3 hours. *Professor E. B. Stavely*

E.E. 525. Symmetrical Components (3).—Polyphase circuits and machines under unbalanced conditions of operation including the effects of rotating machines upon the distribution and transmission system performance; characteristics of phase converters and single-phase operation of polyphase systems. Prerequisite: E.E. 425. Lecture 3 hours. *Professor C. B. Holt*

*No credit if credit has been received for Ed. 70.

E.E. 526a,b. Electric Illumination (3-6).—Problems in photometry; methods of evaluating illumination in terms of safety and seeing value; development of improved methods for illumination calculations. *Professor D. L. Markle*

E.E. 527. Electrical Design Engineering (3).—Special problems in the design of alternating and direct-current apparatus. Lecture and design 3 hours. *Professor L. A. Doggett*

E.E. 528. Servomechanisms (3).—An advanced treatment of the transient and steady-state behavior of closed-cycle control systems with special attention to stability and the design of stabilizing controllers. Prerequisite: E.E. 428. *Professor H. I. Tarpley*

E.E. 529a,b. Precision Measurements (3-6).—Advanced measurements in electricity and magnetism, usually involving the development of laboratory techniques applicable to specific research problems; development of special measuring devices. *Professor D. L. Markle*

E.E. 530. Audio Frequency Engineering (3).—Electrical systems and equipment used in production, recording, amplification, transmission, and measurement of sound. Prerequisite: E.E. 11 or 13. *Professor F. T. Hall Jr.*

E.E. 531a,b,c. Radio Frequency Engineering (3-9).—Radio frequency equipment, measurements, and systems; amplifiers, modulators, demodulators, transmitters, receivers, transmission lines, antennae, and radiators. Prerequisite: E.E. 431. *Professor F. T. Hall Jr.*

E.E. 532. Ultra-High-Frequency Engineering (4).—Theory of transmission lines, wave guides, resonant cavities, antennae, and wave propagation. Prerequisite: E.E. 432. Lecture 3 hours, practicum 3 hours. *Professor F. T. Hall Jr.*

E.E. 533. Automatic Control Systems (2-3).—Automatic control as applied to railway and industrial motors; telemetering and automatic control of electrical, mechanical, thermal, and chemical quantities. Investigation of existing methods and design of equivalent systems. Much of the course may be adapted to the needs of special interests. Prerequisite: E.E. 4. *Professor P. X. Rice*

E.E. 535. Engineering Analysis (3).—The engineering applications of functions of a complex variable, including conformal mapping methods for plotting potential fields, the Laplace transform method for analyzing circuit problems, analysis of stability of servomechanisms. Prerequisite: E.E. 435. Lecture 3 hours. *Professor Norman Davids*

E.E. 538. Electromagnetic Engineering (3).—Electrical and magnetic fields, using the Maxwell-Lorentz equations as applied to vector fields and special solutions for antennae, wave guides, and other engineering applications. Prerequisite: E.E. 438. Lecture 3 hours.

E.E. 550. Communication Networks (3).—Methods of filter design using lattice networks; the effects of dissipation on the characteristics of filter networks; transient response of networks and the design of equalizers. Prerequisite: E.E. 450. Lecture 3 hours. *Professor H. I. Tarpley*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

E.E. 421a,b,c,d. Electrical Engineering Problems (2-12)

E.E. 423. Transient Phenomena (3) *Professor C. B. Holt*

E.E. 424. Engineering Electronics (3)
E.E. 425. Symmetrical Components (3) *Professor C. B. Holt*
E.E. 428. Servomechanisms (3) *Professor H. I. Tarpley*
E.E. 431. High-Frequency Engineering (3) *Professor F. T. Hall Jr.*
E.E. 432. Ultra-High-Frequency Techniques (3) *Professor F. T. Hall Jr.*
E.E. 434. Industrial Electronics (3) *Professor E. B. Stavely*
E.E. 435. Engineering Analysis (3)
E.E. 438. Electricity and Magnetism (3)
E.E. 450. Electrical Network Theory (3) *Professor H. I. Tarpley*
E.E. 460. High Voltage Engineering (3) *Professor R. E. Armington*

ELECTROCHEMICAL ENGINEERING

Professor Eric A. Walker, M.S., Sc.D.
Head of the Department of Electrical Engineering

Ech.E. 501. Theory of Electrochemistry (2-4).—Laboratory study of advanced electrochemical theory; overvoltage and discharge potentials; application of electrochemistry to recent chemical problems. Investigation.
Professor A. F. Woelfel

ENGINEERING

Consult Dean H. P. Hammond, C.E., D.Eng., LL.D.

The following course may be taken for graduate credit under the restrictions in force:
Eng. 400. Production Engineering (2-3)

ENGINEERING EXPERIMENT STATION

Professor F. George Hechler, M.E.
Director

Eng. Exp. Sta. 501. Fuel Injection and Combustion in Diesel Engines (2-6).—Characteristics and efficiency of various injection systems. Lecture 3 hours.
Professor P. H. Schweitzer

Eng. Exp. Sta. 502. Diesel Engine Research (3-15 per semester).—An original investigation dealing with the design, construction, operation, or application of Diesel engines. *Professor P. H. Schweitzer*

Eng. Exp. Sta. 504. Fuel Spray Laboratory (2).—A laboratory study of fuel injection for the Diesel engine. *Professor P. H. Schweitzer*

Eng. Exp. Sta. 505. Transient Elastic Phenomena (2-3).—The analysis, mainly by graphical methods, of transient phenomena in the flow of fluids in pipes with particular attention to the phenomena of injection in Diesel engines; water-hammer in hydraulic conduits; oscillations in the intake and exhaust pipes of engines

and compressors; surges in mechanical springs; surges in electric circuits. Lecture 2 or 3 hours. *Professor K. J. DeJuhasz*

Eng. Exp. Sta. 506. Research in Transient Elastic Phenomena (3-15 per semester).—Laboratory research in the fields described under Eng. Exp. Sta. 505. *Professor K. J. DeJuhasz*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Eng. Exp. Sta. 401. Theory of Engineering Instruments (2-3) *Professor K. J. DeJuhasz*

ENGINEERING MECHANICS

Professor John A. Sauer, M.S., Ph.D.
Head of the Department

Mchs. 500. Advanced Mechanics of Materials (3).—Strain energy methods; special problems in bending of beams including curved bars, beams on elastic foundations; thick-walled cylinders, shrink-fit assemblies, and rotating discs; bending of thin plates; thin-walled pressure vessels; buckling of bars and plates. *Professors J. Marin, D. E. Hardenbergh*

Mchs. 504. Applied Elasticity (3).—A condensation of Mchs. 507 and 508; emphasis on applications to machine and structural design. Prerequisite: Mchs. 13. *Professor J. Marin*

Mchs. 506. Experimental Stress Analysis (3).—Experimental methods of stress determination including photoelasticity, stress coat and electric strain gauge techniques; electrical, hydrodynamic, and membrane stress analogies; strain rosettes for combined stress determinations; special experimental methods for structural analysis. Prerequisite: Mchs. 13. Lecture 2 hours, practicum 3 hours. *Professor J. Marin*

Mchs. 507. Theory of Elasticity and Applications (3-6).—Theory of elasticity; general equations of stress and strain; differential equations of equilibrium, and applications to beams, curved members, rotating discs, thick cylinders, tanks, rollers, rotating cylinders, plates, and other structural and machine parts. Prerequisite: Mchs. 13. Lecture 3 to 6 hours. *Professor J. A. Sauer*

Mchs. 508. Theory of Elastic Stability and Applications (3).—Bending of columns; buckling of slender and short members; influence of eccentricity and initial curvature in columns; buckling of I-beams; stability of thin-walled constructions; thin-walled cylinders subjected to external pressures; applications to structural parts including aircraft members. Prerequisite: Mchs. 13. *Professor J. A. Sauer*

Mchs. 509. Theory of Plates and Shells (3).—Deflection of thin plates; bending of circular and rectangular plates; buckling of plates; plates on elastic foundations; deformation of shells without bending; general theory of cylindrical shells; applications to engineering problems. Prerequisite: Mchs. 13. *Professor J. Marin*

Mchs. 512. History of Mechanics of Materials (2).—Prerequisite: Mchs. 13. *Professors J. Marin, P. B. Kapp*

Mchs. 513. Thesis (1-9)

MCHS. 514. ENGINEERING MECHANICS SEMINAR (1 per semester).—Current literature and special problems in engineering mechanics. Prerequisites: Mchs. 13, 14.

MCHS. 515. RESEARCH IN ENGINEERING MECHANICS (1-15 per semester).—Investigation of a theoretical or experimental project in engineering mechanics.

MCHS. 520. ADVANCED DYNAMICS (3).—Dynamics of a particle and of rigid bodies; Newtonian equations in moving co-ordinate systems; derivation and application of LaGrange's and Hamilton's equations of motion; normal co-ordinates; principle of least action; special problems in vibrations and dynamics. Prerequisite: Mchs. 12. *Professor J. A. Sauer*

MCHS. 522. THEORY OF VIBRATIONS (3).—Mathematical theory of simple vibrating systems; damping phenomena; forced vibrations; analogy between mechanical and electrical vibrations; multiple degree of freedom systems; transverse and torsional oscillation of shafts; vibration of strings, beams, membranes, and plates. Prerequisites: Mchs. 13, Math. 84 or 431. *Professor J. A. Sauer*

MCHS. 523. VIBRATION PROBLEMS IN ENGINEERING (3).—Application of vibration theory to problems of suspension; vibration isolation in machines, ships, and automobiles; torsional oscillation of crankshafts; vibrations of bridges, turbine blades, propeller blades; self-induced vibrations; nonlinear vibrational systems and applications. Prerequisite: Mchs. 522. *Professor J. A. Sauer*

MCHS. 530. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3).—True stress-strain relations in tension; plastic stress-strain equations for combined stresses; theories of failure for combined static and fatigue stresses; impact loads; creep of metals subjected to simple and combined stresses. Application to design of structural and machine elements. Prerequisite: Mchs. 13. *Professor J. Marin*

MCHS. 531. THEORY OF PLASTICITY AND APPLICATIONS (3).—Theory of plasticity including plastic torsion and bending of bars; plastic flow in thick-walled cylinders and rotating discs; buckling of bars loaded beyond the yield point and residual stresses; mechanics of creep for members subjected to combined stresses. Applications to specific problems in structural and machine design. Prerequisite: Mchs. 530. *Professor J. Marin*

MCHS. 533. ADVANCED MATERIALS TESTING (3).—Special experiments in materials testing including fatigue, creep, impact, and combined stress studies; determination of true stress-strain diagrams of metals. Lecture 1 hour, practicum 6 hours. *Professors R. K. Vierck, P. B. Kapp*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MCHS. 400. ADVANCED STRENGTH OF MATERIALS (3)
Professors J. Marin, D. E. Hardenbergh

MCHS. 401. ELEMENTS OF VIBRATIONS (3)
Professors R. K. Vierck, J. A. Sauer

MCHS. 402. APPLIED AND EXPERIMENTAL STRESS ANALYSIS (3)
Professor J. Marin

MCHS. 403. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3)
Professor J. Marin

MCHS. 404. RESEARCH IN ENGINEERING MECHANICS (1-6)

MCHS. 405. THEORETICAL STRESS ANALYSIS (3)
Professors J. W. Breneman, R. K. Vierck

ENGLISH COMPOSITION

Professor Theodore J. Gates, M.A.
Head of the Department

Engl. Comp. 502. Ancient Rhetoric and Poetic (3).—Rhetorical and poetic doctrine as set forth by the ancients from Aristotle to Horace. Recitation 3 hours.

Engl. Comp. 503. Medieval Rhetoric (3).—Rhetorical and poetic doctrine and practice during the Middle Ages. Recitation 3 hours.

Engl. Comp. 504. Renaissance Rhetoric (3).—The rhetorical and poetic doctrine and practice during the Renaissance. Recitation 3 hours.

Engl. Comp. 505. Modern English Rhetoric (3).—A survey of British and American rhetorical doctrine from 1600 to the present. Recitation 3 hours.
Professor J. J. Rubin

Engl. Comp. 510. Prose Style (3).—The development of English prose style from the Elizabethan age to Dryden. Recitation 3 hours.
Professor J. C. Major

Engl. Comp. 511. Modern Prose Style (3).—English prose style from 1700 to the present. A continuation of Engl. Comp. 510. Recitation 3 hours.
Professor J. C. Major

Engl. Comp. 520. Semantics (3).—Special studies in semasiology. Recitation 3 hours. *Professor L. F. Peck*

Engl. Comp. 528. Advanced English Grammar (3).—A comprehensive study of the grammatical structure of the English language; methods of recording syntactic analysis; problems of terminology; a critical evaluation of the systems advanced by recent grammarians. Prerequisite: 6 credits in the field of English language. Recitation 3 hours.

Engl. Comp. 529. Historical English Grammar (3).—The evolution of the grammatical system of English; inflectional change and decay; the development of form words and word order as grammatical means; the influence of 18th century grammarians; present-day trends. Prerequisite: graduate standing with a major or a minor in English or a foreign language. Recitation 3 hours.

Engl. Comp. 530. Rhetorical Techniques (3).—Studies in the techniques of special types of writing, such as humor, satire, and propaganda. Prerequisites: 12 credits in English or American literature and 12 credits in English composition. Recitation 3 hours. *Professor H. F. Graves*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Engl. Comp. 404. Public Opinion and Written Persuasion (3)
Professor H. F. Graves
Engl. Comp. 410a,b,cS. Survey of English Composition (1-3)
Engl. Comp. 411a,b,cS. Spoken and Written English (1-3)
Engl. Comp. 418. The Writing of Literary Criticism (3)
Professor J. J. Rubin

ENGLISH LITERATURE

Professor Brice Harris, M.A., Ph.D.
Head of the Department

Engl. Lit. 501. Materials and Methods of Research for English Literature (3).—The bibliography of literary history and criticism; methods of editing and annotating texts; the form and materials of dissertations. Required of all graduate students with an English literature major. *Professor C. O. Ridenour*

Engl. Lit. 505. The American Short Story (3).—Lecture 3 hours. *Professor W. L. Werner*

Engl. Lit. 506. History of American Poetry (3).—Lecture 3 hours. *Professor W. L. Werner*

Engl. Lit. 507. Research Problems in English (1-6).—The methods of research in English, the problems of bibliography, and the method of evaluating sources and materials. Lecture 1 to 6 hours.

Engl. Lit. 508. Beowulf (3).—A reading of the text and a study of the prominent literary problems and relationships. Prerequisite: Engl. Lit. 31. Lecture 3 hours. *Professor D. S. Mead*

Engl. Lit. 509. Nondramatic Writers of the Elizabethan Period: The Prose Writers (3) *Professor D. S. Mead*

Engl. Lit. 510. Nondramatic Writers of the Elizabethan Period: The Poets (3) *Professor A. P. Locklin*

Engl. Lit. 511. Elizabethan Drama (3).—Lecture 3 hours. *Professor Brice Harris*

Engl. Lit. 512. History of the American Novel (3).—Lectures and reports. Lecture 3 hours. *Professor W. L. Werner*

Engl. Lit. 513. American Essays (3).—Lectures and reports on a special group of essayists. Lecture 3 hours. *Professor W. L. Werner*

Engl. Lit. 514. Shakespeare (3).—Special problems in the works of Shakespeare. Lecture 3 hours.

Engl. Lit. 515. The Age of Swift (3).—Special studies varying from year to year. Lecture 3 hours. *Professor Brice Harris*

Engl. Lit. 516. The Age of Johnson (3).—The work of Johnson and his circle. Lecture 3 hours. *Professor D. S. Mead*

Engl. Lit. 517. Byron, Shelley, and Keats (3) *Professor C. O. Ridenour*

Engl. Lit. 518. Pre-Romantic Writers (3).—Development of Romantic ideas in the 18th century. *Professor C. O. Ridenour*

Engl. Lit. 519. Wordsworth, Coleridge, Southey, and Scott (3) *Professor C. O. Ridenour*

Engl. Lit. 520. Prose Writers of the Romantic Period (3) *Professor C. O. Ridenour*

ENGL. LIT. 531. OLD ENGLISH (3).—Old English language and literature with lectures on Old English and Germanic philology. *Professor D. S. Mead*

ENGL. LIT. 532. MIDDLE ENGLISH (3).—Middle English language and literature with lectures on the development of Old English through Middle English to modern times. *Professor D. S. Mead*

ENGL. LIT. 533. LITERARY CRITICISM (3).—An historical survey of the principles of literary criticism. *Professor D. S. Mead*

ENGL. LIT. 540. CHAUCER (3).—Analysis of Chaucer's poetry in the light of its background, sources, and subsequent influences. *Professor D. S. Mead*

ENGL. LIT. 543. CAVALIER AND ANGLICAN (3).—The poetry and prose of the middle years of the 17th century from the death of Shakespeare to 1660. *Professor D. S. Mead*

ENGL. LIT. 544. RESTORATION LITERATURE (3).—Selected studies in the writers in England between 1650 and 1700. *Professor Brice Harris*

ENGL. LIT. 545. THE PRE-RAPHAELITES (3) *Professor Mason Long*

ENGL. LIT. 546. TENNYSON AND BROWNING (3) *Professor Mason Long*

ENGL. LIT. 547. CARLYLE, RUSKIN, AND ARNOLD (3) *Professor Mason Long*

ENGL. LIT. 550. SELECTED STUDIES IN THE BRITISH NOVEL TO 1840 (3) *Professor T. D. Bowman*

ENGL. LIT. 551. SELECTED STUDIES IN THE BRITISH NOVEL FROM 1840 TO THE PRESENT (3) *Professor A. B. Sutherland*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ENGL. LIT. 400. TEACHERS' COURSE IN LITERATURE (3) *Professor D. K. Merrill*

ENGL. LIT. 401. MAIN CURRENTS IN AMERICAN LITERATURE (3) *Professor D. K. Merrill*

ENGL. LIT. 423. FORMS AND MOVEMENTS OF BRITISH LITERATURE (3) *Professor C. O. Ridenour*

ENGL. LIT. 439a,b,cS. OUR CONTEMPORARIES (3)

ENGL. LIT. 440a,b,cS. MASTERS OF LITERATURE (1-3)

ENGL. LIT. 441a,b,cS. MASTERS OF ENGLISH LITERATURE (1-3)

ENGL. LIT. 460, 460X. LITERARY BIOGRAPHY (3) *Professor D. K. Merrill*

ENGL. LIT. 464. SPENSER (3) *Professor A. P. Locklin*

ENGL. LIT. 466. MILTON (3) *Professor Brice Harris*

ENGL. LIT. 475a,b,cS. WORLD LITERATURE IN ENGLISH (3-9)

ENGL. LIT. 484, 484X. AMERICAN DRAMA (3) *Professor A. C. Cloetingh*

ENGL. LIT. 485. SCANDINAVIAN DRAMA (3) *Professor A. C. Cloetingh*

ENGL. LIT. 486. LATER BRITISH AND IRISH DRAMATISTS (3) *Professor A. C. Cloetingh*

ENGL. LIT. 487. MODERN CONTINENTAL DRAMA (3) *Professor A. C. Cloetingh*

ENGL. LIT. 489a,b,cS. COMPOSITE COURSE IN DRAMA (3-9)

ENGL. LIT. 489dS. CONTEMPORARY DRAMA (3)

ENTOMOLOGY

PROFESSOR EDWARD H. DUSHAM, M.S., Ph.D.
Head of the Department of Zoology and Entomology

ENT. 500. INSECT HISTOLOGY (5).—The microscopic structure of insect tissues and organs. Prerequisites: Ent. 5, Zool. 31. Lecture 2 hours, practicum 7½ hours. *Professor G. B. Newman*

ENT. 501. MEDICAL ENTOMOLOGY (3).—The role played by insects in the causation and transmission of disease. Prerequisites: Ent. 2, Zool. 432. Lecture 2 hours, practicum 3 hours.

ENT. 502. THE LEPIDOPTERA (3).—The morphology, taxonomy, and relationships of the lepidoptera. Prerequisites: Ent. 3, 5. Practicum 9 hours. *Professor H. M. Tietz*

ENT. 503. THE COCCIDAE (3).—A laboratory course dealing with the identification of this important group of insects; practice in the preparation of permanent mounts for study. Prerequisites: Ent. 3, 5. Practicum 9 hours. *Professor E. H. Dusham*

ENT. 505. ADVANCED MORPHOLOGY OF INSECTS (3).—Advanced work in either the external or internal morphology of insects. Prerequisite: Ent. 500. Practicum 9 hours.

ENT. 506. IMMATURE INSECTS (2).—The morphology and taxonomy of the immature stages of insects. Prerequisites: Ent. 3, 5. Practicum 6 hours. *Professor S. W. Frost*

ENT. 508. THE BIOLOGICAL CONTROL OF INSECTS (2).—The artificial use of bacteria, fungous diseases, and animals in the control of injurious insects; methods and equipment for rearing parasites and predators on a large scale. Prerequisites: Ent. 4, 6, 8, 407. Lecture 2 hours. *Professor S. W. Frost*

ENT. 509. ENTOMOLOGICAL TECHNIQUE (2).—For advanced students dealing with special methods of collecting, rearing living insects, preparing and preserving immature stages, keeping records, and preparing illustrations for manuscript. Prerequisite: Ent. 4 or 6. Lecture 2 hours. *Professor S. W. Frost*

ENT. 510. THE DIPTERA (3).—The morphology, taxonomy, and relationships of the diptera. Prerequisites: Ent. 3, 5. Practicum 9 hours. *Professor S. W. Frost*

ENT. 511. THE ORTHOPTERA (3).—The morphology, taxonomy, and relationships of the orthoptera. Prerequisites: Ent. 3, 5. Practicum 9 hours.

ENT. 528. INSECT PHYSIOLOGY (2).—The normal functions of the insect body. Prerequisites: Ent. 5, Zool. 41. Lecture 2 hours. *Professor L. E. Dills*

ENT. 534. INSECT EMBRYOLOGY (2).—The origin and development of the tissues and organs of insects. Prerequisite: Ent. 500. Lecture 2 hours. *Professor G. B. Newman*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ENT. 407. INSECT ECOLOGY (2) *Professor S. W. Frost*
ENT. 413. ENTOMOLOGY SEMINAR (1 per semester) *Professor S. W. Frost*
ENT. 429. PRINCIPLES OF INSECT CONTROL (2) *Professor S. W. Frost*

FORESTRY

Professor Victor A. Beede, M.F.
Head of the Department

For. 500. National and State Administration (3-5).—Comparison of the policy and administration of the national forests with the forests of other countries and of the different states. Lecture 1 hour, practicum 5 to 10 hours.
Professor V. A. Beede

For. 502. Wood Fibers (3-5).—Identification and physical and chemical characteristics of wood fibers used for pulp, either for paper or as a source of cellulose. Pulping quality, fiber measurements. Lecture and practicum.
Professor W. E. White

For. 504. Research Methods in Forestry (2-6 per semester).—Review of methods employed in conducting forestry research. Recitation, conferences, practicum. *Professor W. C. Bramble*

For. 508. Forest Ecology (2-4).—The organization, development, and classification of forest communities. *Professor W. C. Bramble*

For. 509. Covert Management (2).—Management of forest associations for maintenance and development of wildlife. Prerequisite: For. 508.
Professor W. C. Bramble

For. 510. Seminar (1-2 per semester).—Current problems of forest research presented as weekly seminar reports. May be repeated with additional credit for each semester's work. *Professor W. C. Bramble*

For. 530. Research in Wood Utilization (3-6 per semester).—Research in some chosen phase of wood utilization or forest products. Prerequisite: For. 431. Lecture and practicum hours to be arranged. *Professor N. A. Norton*

For. 531. Structural Uses of Wood and Wood Products (3-6 per semester).—Wood as a construction material; testing techniques for structural timbers and wood assemblies; use of laminated wood, ring connectors, and other types of special construction. Prerequisite: For. 404. Lecture and practicum hours to be arranged. *Professor N. A. Norton*

For. 532. Laminates (3-6 per semester).—Advanced and special studies in the fabrication and use of plywood, laminated wood, paper-base laminates, and wood-to-metal bonding. Prerequisite: For. 405. Lecture and practicum hours to be arranged. *Professor N. A. Norton*

For. 535. Conditioning Treatments for Wood (3-6 per semester).—Advanced study and problems in preservative, seasoning, and other special treatments for wood and wood products. Prerequisite: For. 435. Lecture and practicum hours to be arranged. *Professor N. A. Norton*

For. 550. Forest Mensuration (2-8 per semester).—Research in some chosen field. Prerequisite: For. 450. Lecture, conferences, practicum.
Professor H. A. Meyer

For. 560. Forest Management (3-8).—Special topics in forest management and research in some chosen field. Prerequisite: For. 466. Hours to be arranged.
Professor H. A. Meyer

For. 575. Applications of Forest Economics and Finance (3 per semester).—Survey of situations in forestry where business problems and particular circum-

stances of production, value, and costs are currently significant. Prerequisite: For. 70. Hours to be arranged. *Professor M. W. Humphrey*

For. 590. The Lumber Industry (2-4).—The relation of the lumber industry to national economy and world trade; lumbermen's associations; lumber accounts. Prerequisite: For. 430. Lecture 2 to 4 hours.

For. 591. Problems in Lumbering (2-6).—Research in some chosen phase of lumbering. Prerequisite or concurrent: For. 590. Lecture and practicum hours to be arranged.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

For. 400. Advanced Silviculture (2) *Professor W. C. Bramble*
For. 402. Forest Research (2) *Professor W. C. Bramble*
For. 404. Mechanical Properties of Wood (3) *Professor N. A. Norton*
For. 405. Veneer and Plywood (3) *Professor N. A. Norton*
For. 406. Forestry Literature (1) *Professor W. E. White*
For. 417. National and State Forest Practice (2) *Professor V. A. Beede*
For. 421. Regional Silviculture (4) *Professor H. N. Cope*
For. 427. Forest Uses (3) *Professor W. C. Bramble*
For. 430. Forest Products and Industries (3) *Professor N. A. Norton*
For. 431. Advanced Utilization (2-4) *Professor N. A. Norton*
For. 435. Seasoning and Preservation (3) *Professor N. A. Norton*
For. 445. Improvements (3)
For. 446. Forest Park Administration (3)
For. 450. Advanced Mensuration (2) *Professor H. A. Meyer*
For. 451. Statistics in Forestry and Wood Utilization (3) *Professor H. A. Meyer*
For. 455. Aerial Photogrammetry in Forest Management (2)
For. 462. Advanced Wood Technology (2) *Professor W. E. White*
For. 466. Forest Management and Management Plans (4) *Professor H. A. Meyer*
For. 468. Silvicultural Research (2-4) *Professor W. C. Bramble*
For. 469. Problems in Forest Management (3) *Professor H. A. Meyer*
For. 475. Problems in Forest Economics and Finance (3) *Professor M. W. Humphrey*
For. 480. Policy and Administration (3) *Professor V. A. Beede*
For. 491. Lumbering (3)
For. 492. Lumber Distribution (3)
For. 494. Logging (3)
For. 495. Milling (3)
For. 497. Small Sawmills (3)

FRENCH

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

ACADEMIC YEAR

Fr. 544. Neo-Classicism in the Romance Literatures (3).—The nature and development of the Neo-classic movement in Italy, France, Spain, and Portugal. Prerequisite: Fr. 40. Lecture 3 hours.

Fr. 545. Romanticism in the Romance Literatures (3).—The nature and development of the Romantic movement in Italy, France, Spain, and Portugal. Prerequisite: Fr. 40. Lecture 3 hours.

Fr. 551. Romance Philology (3).—Historical development of the Romance languages. Recitation 3 hours.

Fr. 552. Old and Middle French Readings and Literature (3).—Familiarizes the student with Old and Middle French texts from the earliest monument to Villon. Prerequisite: Fr. 551. Recitation 3 hours.

Fr. 553. French Literature of the Renaissance (3).—The French Renaissance from 1498 to 1548. Lectures, discussions, and reports. Recitation 3 hours.

Fr. 554. French Literature of the Renaissance (3).—The French Renaissance from 1548 to 1594. Lectures, discussions, and reports. Recitation 3 hours.

Fr. 557. French Romantic Poetry (3)

Fr. 562. French Thinkers of the 18th Century (3).—Recitation 3 hours.

Fr. 564. French Romanticism (3).—The French Romantic Movement after 1830. Lectures, discussions, and reports. Recitation 3 hours.

Fr. 570. Voltaire and Rousseau (3)

Fr. 571. Seminar in French Literature (3).—Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor. Recitation 3 hours.

Fr. 572. Seminar in French Literature (3).—Continuation of Fr. 571. Recitation 3 hours.

Fr. 573. Research in French Literature (3).—In addition to the regular courses there will be an opportunity for students adequately prepared to earn from 1 to 3 credits through research.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fr. 400. French Literature of the 16th Century (3)
Fr. 401, 401X. French Theater of the Classical Period (3)
Fr. 402. French Theater of the Classical Period (3).—Continuation of Fr. 401.
Fr. 403. French Dramatic Literature of the 18th Century (3)
Fr. 405. French Literature of the 19th Century (3)
Fr. 406. French Literature of the 19th Century (3)
Fr. 407. French Novel of the 19th Century (3)
Fr. 408. French Novel of the 19th Century (3)
Fr. 410. French Contemporary Poetry (3)
Fr. 413. Contemporary French Drama (3)
Fr. 414. Contemporary French Drama (3)
Fr. 415. French Novel of the 18th Century (3)
Fr. 421. The Teaching of Romance Languages (3)
Fr. 425. Professional Translating from French into English (3)
Fr. 496. Literary Criticism in France, Italy, and Spain (3)

MAIN SUMMER SESSION

Fr. 505S. The Great Writers of France: Balzac (2)
Fr. 507S. La Fontaine and His Time (2)
Fr. 528S. French Lyric Poetry of the 19th Century (2)
Fr. 531S. French Novelists of the Romantic School (2)
Fr. 538S. The Romantic Poets (2)
Fr. 540S. Contemporary French Drama (2)
Fr. 541S. Modern French Drama (2)
Fr. 542S. The French Short Story of the 19th Century (2)
Fr. 555S. Victor Hugo and His Time (2)
Fr. 556S. Charles Baudelaire (2)
Fr. 557S. French Romantic Poetry (2)
Fr. 559S. France Between Two Wars (2)
Fr. 560S. Moliere and the Classical Comedy (2)
Fr. 565S. French Literature of the 19th Century (2)
Fr. 566S. Classical French Literature (2)
Fr. 567S. The French Novel from 1870 to 1914 (2)
Fr. 568S. The Contemporary Novel (2)
Fr. 570S. Voltaire and Rousseau (2)
Fr. 573S. Research in French Literature (1-3)
Fr. 575S. Advanced Phonetics (2)
Fr. 576S. Composition and Stylistics (2)
Fr. 577S. Advanced Composition and Stylistics (3-6)
Fr. 579S. Research Laboratory in Phonetics (1)
Fr. 587S. French Novelists of the 18th Century (2)
Fr. 588S. French Poetry: from Baudelaire to the Symbolists (2)
Fr. 591S. French in the Secondary Schools (3)
Fr. 592S. French and Spanish in the Secondary Schools (3)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fr. 409S. Advanced Course in Pronunciation and Conversation (2)
Fr. 469S. French Civilization of the 19th Century (2)
Fr. 490S. Grammar and Composition (3)
Fr. 493S, 493X. Elementary Phonetics (2)
Fr. 495S. Advanced Composition and Syntax (3)
Fr. 498S. Intermediate Phonetics (2)

FUEL TECHNOLOGY

Professor C. C. Wright, Ph.D.
Chief of the Division

Fuel T. 501. Coal Petrography (2).—The microscopic examination of coals for the determination of coal type and vegetable origin. Prerequisite or concurrent: Fuel T. 503. Practicum 6 hours. *Professor C. R. Kinney*

Fuel T. 502. Research Data (3).—Methods of obtaining and interpreting research data; designed for the graduate student beginning laboratory research. Prerequisite: Math. 30. Lecture 3 hours. *Professor R. F. Nielsen*

Fuel T. 503. Chemical Constitution and Scientific Classification of Coal (3-6).—The chemistry of plant constituents in relation to coal and the coalifi-

cation process; constitution of coal as deduced by chemical methods; scientific classification of coals. Prerequisite: Chem. 31. *Professor C. R. Kinney*

FUEL T. 504. FUEL TECHNOLOGY RESEARCH (1-15 per semester).—Original research on preparation, carbonization, processing, utilization, or constitution of fuels. Results of the investigation may be used as the thesis. Prerequisites: Fuel T. 502, 503. *Professor C. C. Wright and Staff*

FUEL T. 505. PHYSICOCHEMICAL PROPERTIES OF COAL, MINERAL MATTER, AND ASH (3).—The physical, physicochemical, and use properties of coals, mineral matter, and coal ash; their significance and application in the preparation and use of coals; ash fusibility, clinker formation, and slagging. Prerequisite: Chem. 41. Lecture 3 hours. *Professor J. D. Clendenin*

FUEL T. 506. ADVANCED COMBUSTION (3).—Advanced combustion and heat balance calculations, ignition and flame characteristics of fuels; furnace atmospheres; selection of fuels with reference to use and equipment. Prerequisite: Chem. 41. Lecture 3 hours. *Professor C. C. Wright*

FUEL T. 507. ADVANCED THERMAL PROCESSING (3).—Pyrolysis of carbon compounds; coal carbonization methods and economics; significance of rank and composition in thermal processing and utilization; metallurgical and gas making coke requirements and properties; process control. Prerequisites: Chem. 35, 41, or Min. Prep. 410. Lecture 3 hours. *Professor J. D. Clendenin*

FUEL T. 508. SYNTHESIS OF LIQUID FUELS (3).—The chemical nature of liquid fuels, lubricating oils, and hydrocarbons of synthetic processes; preparation of hydrogen and synthesis gas; hydrogenolysis of pure compounds, oils, tars, and coal; theoretical aspects of Fischer-Tropsch and related processes. Prerequisites: Chem. 31, Fuel T. 402. Lecture 3 hours. *Professor H. B. Charmbury*

FUEL T. 509. TECHNOLOGY OF TARS (3).—Theories of tar formation; chemical constitution of tars and their physical and chemical properties; methods of separation, refining, and purification; uses of tars and tar products. Coal, oil, and water-gas tars are considered. Prerequisite: Chem. 31. Lecture 3 hours. *Professor T. S. Polansky*

FUEL T. 510. FUEL TECHNOLOGY PROBLEM (1-6 per semester).—Special problems in fuel technology. Prerequisite: Fuel T. 503. *Professor C. C. Wright and Staff*

FUEL T. 511. FUEL TECHNOLOGY SEMINAR (1-6).—Selected topics from current fuel technology research examined and discussed. Prerequisite: Chem. 35 or 41. *Professor C. C. Wright and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

FUEL T. 400. FUEL TECHNOLOGY RESEARCH AND DESIGN (3) *Professor C. C. Wright and Staff*

FUEL T. 401. FUEL GASES AND GASIFICATION (3) *Professors C. C. Wright, H. B. Charmbury*

FUEL T. 402. CHEMICAL PROCESSING OF FUELS (2) *Professor H. B. Charmbury*

FUEL T. 403. ENERGETICS OF FUEL TECHNOLOGY (3) *Professor A. W. Gauger*

FUEL T. 404. FUEL TECHNOLOGY DESIGN (3) *Professor T. S. Spicer*

GEOGRAPHY

Professor E. Willard Miller, M.A., Ph.D.
Chief of the Division

Geog. 503. Advanced Regional Geography (3-12).—Intensive study at an advanced level of selected regions or sections of the continents. Lectures, reports, and discussion. Prerequisite: 12 credits in geography.
Professors E. W. Miller, G. F. Deasy

Geog. 504. Physical Geography Seminar (3-12).—The literature of some phase of physical geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professors E. W. Miller, G. F. Deasy*

Geog. 505. Economic Geography Seminar (3-12).—The literature of some phase of economic geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor E. W. Miller*

Geog. 506. Cultural and Political Geography Seminar (3-12).—The literature of some phase of cultural and political geography with emphasis on procedures for organizing material for classroom reports and discussions.

Geog. 510. Physical Geography Research (3-10).—Original study in some phase of physical geography. This may be a field problem or a problem which requires detailed library investigation together with analysis and presentation of data and statistics. Results of investigation may form basis for thesis.
Professor G. F. Deasy

Geog. 511. Economic Geography Research (3-10).—Original study in some phase of economic geography research. This may be a field problem or a problem which requires detailed library investigation together with analysis and presentation of data and statistics. Results of investigation may form basis for thesis.
Professor E. W. Miller

Geog. 512. Cultural and Political Geography Research (3-10).—Original study in some phase of cultural and political geography research. This may be a field problem or a problem which requires detailed library investigation together with analysis and presentation of data and statistics. Results of investigation may form basis for thesis.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Geog. 400. Regional Geography of North America (3)
Professor G. F. Deasy
Geog. 401. Regional Geography of Pennsylvania (3)
Professor E. W. Miller
Geog. 402. Regional Geography of Middle America (3)
Geog. 403. Regional Geography of South America (3)
Geog. 405. Cultural Geography (3)
Geog. 433. Regional Climatology (3) *Professor G. F. Deasy*
Geog. 435. Field Methods in Geography (3) *Professor E. W. Miller*
Geog. 442. Geography of Europe (3) *Professor E. W. Miller*
Geog. 443. Geography of the Orient (3) *Professor G. F. Deasy*
Geog. 444. Geography of Africa (3)
Geog. 445. Geography of the Air Age (3) *Professor E. W. Miller*

GEOG. 452. INTERPRETATION OF AERIAL PHOTOGRAPHS (3)
Professor G. F. Deasy

GEOG. 460. POLITICAL GEOGRAPHY (3)

GEOG. 480. GEOGRAPHY OF WORLD MANUFACTURING (3)
Professor E. W. Miller

GEOLOGY

PROFESSOR FRANK M. SWARTZ, Ph.D.
Chief of the Division

*GEOL. 500. GEOLOGY SEMINAR (1-9).—Intensive study of any of the following: coal, oil and gas, clays, ore deposits, historical geology, metamorphic and structural geology, paleontology.

†GEOL. 501. STRATIGRAPHY (3-12).—Stratigraphic principles, with particular reference to outstanding problems of North American geology.
Professor F. M. Swartz

‡GEOL. 502. GEOLOGICAL RESEARCH (3-18).—An original investigation of a geological problem approved by the chief of the division. Results of the investigation may be used for the thesis.

†GEOL. 503. PALEONTOLOGY (3-9) *Professor F. M. Swartz*

§GEOL. 504. ADVANCED GENERAL GEOLOGY (3-6).—The history of geology with comparison of classical and modern geologic concepts of volcanism, magmatic intrusion, sedimentation, diastrophism, geotectonics, and metamorphism. Prerequisite: graduate standing in geology. *Professors P. D. Krynine, J. E. Allen*

GEOL. 505. PALEOGEOGRAPHY (3-4).—Identification of the geography and relief of the past and reconstruction of ancient climates by methods of sedimentary petrography. Prerequisite: Min. 485. *Professor P. D. Krynine*

§GEOL. 507. GEOMORPHOLOGY (3-9).—Processes involved in the development of land forms; relationships to structural and lithologic features; interpretation of the history of development; principles of description and classification. Prerequisite: Geol. 32. *Professor J. E. Allen*

†GEOL. 511. ORE DEPOSITS, PRINCIPLES (3-6).—An advanced study of the fundamental theories of ore deposition; critical examination of those factors which control locus and extent of mineralization; interpretation of criteria by which geologic processes are recognized and their significance evaluated. Prerequisite: Geol. 482.
Professor J. D. Ridge

†GEOL. 512. ORE DEPOSITS, TYPES (3-6).—The geologic history of selected ore bodies with respect to forming media; causes, sequences, and loci of emplacement; alteration. Microscopic investigation of ore and rock specimens. Prerequisites: Geol. 452, 511, Min. 461, 483. *Professor J. D. Ridge*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GEOL. 451. ECONOMIC GEOLOGY (3) *Professor J. D. Ridge*

GEOL. 461. PHYSIOGRAPHY OF THE UNITED STATES (3)
Professor J. E. Allen

* Credits to be arranged, 1 to 6 per semester.
† Credits to be arranged, 3 to 6 per semester.
‡ Credits to be arranged, 3 to 9 per semester.
§ Credits to be arranged, 3 per semester.

Geol.	464.	Paleontology (3)	*Professor F. M. Swartz*
Geol.	481.	Geology of Oil and Gas (3)	
Geol.	482.	Metallic Mineral Deposits (3)	*Professor J. D. Ridge*
Geol.	483.	Structural Geology (3)	*Professor F. M. Swartz*
Geol.	484.	Paleozoic Stratigraphy (3)	*Professor F. M. Swartz*
Geol.	485.	Paleontology (2)	*Professor F. M. Swartz*
Geol.	486.	Stratigraphic Methods (1)	*Professor F. M. Swartz*
Geol.	488.	Earth Sciences Seminar (1)	
Geol.	489.	Earth Sciences Report (1)	

GEOPHYSICS AND GEOCHEMISTRY

Professor S. J. Pirson, M.C.E., M.S., D.Sc.
Chief of the Division

Geophys. 500. Geophysical Seminar (1-3).—Discussion of geophysical reports and papers; scientific outlook. Prerequisites: Geophys. 401, 402. Lecture 1 to 3 hours. *Professor S. J. Pirson*

Geophys. 501. Geophysical Research (3-12).—Research work in theoretical and applied geophysics; especially the branches of the seismology and geophysical methods of exploration. Practicum 3 hours per credit. *Professor S. J. Pirson*

Geophys. 502. Selected Chapters of Advanced Geophysics (2).—Lecture, review, and discussion of current problems in geophysics; topics not covered in Geophys. 401, such as seismological theory, geological effects of geophysical events. Given alternate years. Prerequisite: Geophys. 401. Lecture 2 hours.
Professor S. J. Pirson

Geophys. 503. Geophysical Surveys (3-6).—An advanced course in the theory of geophysical methods of exploration and interpretation of data. Prerequisites: Geophys. 402, Math. 100. Lecture and practicum 3 to 18 hours.
Professor S. J. Pirson

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Geophys.	401.	Mineral Geophysical Prospecting (3)	*Mr. L. O. Bacon*
Geophys.	402.	Petroleum Geophysical Prospecting (4)	*Professor S. J. Pirson*
Geophys.	403.	Geophysics Field Work (3).—Summer practicum.	*Mr. L. O. Bacon*
Geophys.	404.	Geophysical Prospecting Problems (3)	*Mr. L. O. Bacon*
Geophys.	405.	Introductory Geophysics (3)	*Professor S. J. Pirson*
Geophys.	406.	Introductory Geochemistry (3)	*Professor S. J. Pirson*

GERMAN

Professor Philip A. Shelley, A.M., Ph.D.
Head of the Department

Ger. 501. German Language Seminar (3-9).—Critical study of special problems in the Germanic languages, with emphasis on Gothic and the High German dialects in different eras. Papers.

GER. 515. GERMAN LITERATURE SEMINAR (3-9).—Special aspects and characteristics of individual writers and various types of literature, with reference to the political, economic, social, and religious conditions of the times and to significant geographical and ethnological factors. Discussions, papers.

GER. 524. INTENSIVE STUDY OF THE LIFE AND WORKS OF GOETHE (3).—Various phases of the poet's life and individual works. Lectures, discussions, papers. Recitation 3 hours. *Professor A. F. Buffington*

GER. 531. SPECIAL STUDIES IN THE GERMAN LYRIC (3).—Special aspects of the German lyric, including groups, such as the *Göttinger Hainbund,* movements, such as Romanticism; and poets, such as Walther von der Vogelweide, Goethe, Hölderlin, Eichendorff, Heine, Mörike, George, Hofmannsthal, and Rilke. Lectures, discussions, papers. Recitation 3 hours. *Professor P. A. Shelley*

GER. 532. SPECIAL STUDIES IN THE GERMAN DRAMA (3).—Special phases of the German drama, with attention to types; emphasis upon such writers as Hans Sachs, Lessing, Goethe, Schiller, Kleist, Grillparzer, Büchner, Hebbel, Hauptmann, Hofmannsthal, etc. Lectures, discussions, papers. Recitation 3 hours. *Professor Helen Adolf*

GER. 533. SPECIAL STUDIES IN THE GERMAN SHORT STORY (3).—Emergence and development of the short story as a literary form in Germany, treating different features of the *Novelle* and the *Kurzgeschichte* from Goethe to contemporary writers. Lectures, discussions, papers. Recitation 3 hours. *Professor Herbert Steiner*

GER. 534. SPECIAL STUDIES IN THE GERMAN NOVEL (3).—Particular phases of the German novel, especially of the *Bildungsroman,* from its beginnings to the present; novels of the 17th century, such as Grimmelshausen's *Simplicissimus,* and those by succeeding writers, such as Wieland, Goethe, Jean Paul, Novalis, Keller, Fontane, Thomas Mann, Ricarda Huch, Kafka, and Werfel. Lectures, discussions, papers. Recitation 3 hours. *Professor Helen Adolf*

GER. 551. MIDDLE HIGH GERMAN (3).—Extensive reading of texts; characteristics of the various dialects. Lectures, discussions, papers. Recitation 3 hours. *Professor A. F. Buffington*

GER. 552. OLD HIGH GERMAN (3).—Essentials of the grammar, with special treatment of the High German sound shift and of ablaut and umlaut. Reading of works written before 1100 A. D. Papers. Recitation 3 hours. *Professor A. F. Buffington*

GER. 553. GOTHIC (3).—Essentials of the grammar; reading of Ulfilas' Bible translation. Suitable also for advanced students in English. Papers. Recitation 3 hours. *Professor Helen Adolf*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GER. 400. PROSEMINAR IN BIBLIOGRAPHY AND METHODS OF RESEARCH (2) *Professor P. A. Shelley*

GER. 401. HISTORY OF THE GERMAN LANGUAGE (3) *Professor A. F. Buffington*

GER. 421. GERMAN LITERATURE IN THE 18TH CENTURY (3) *Professor A. F. Buffington*

GER. 422. GERMAN LITERATURE IN THE 19TH CENTURY (3)
Professor Helen Adolf

GER. 423. GERMAN LITERATURE OF THE 20TH CENTURY (3)
Professor Herbert Steiner

GER. 443. LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3)
Professor P. A. Shelley

GREEK

PROFESSOR ROBERT E. DENGLER, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

GREEK 500. GREEK COMPOSITION (2).—Translation of extended narrative passages into Attic Greek; a thorough review of forms and syntax; attention to the rhetorical elements of the language. Recitation 2 hours. *Professor R. E. Dengler*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

GREEK 411S. ESSENTIALS OF GREEK (3)
GREEK 421. GREEK TRAGEDY (3) *Professor R. E. Dengler*
GREEK 422. GREEK COMEDY (3) *Professor R. E. Dengler*
GREEK 423. ATTIC ORATORS (3) *Professor R. E. Dengler*
GREEK 424. GREEK HISTORY OR PHILOSOPHY (3) *Professor R. E. Dengler*
GREEK 427. NEW TESTAMENT GREEK (3) *Professor R. E. Dengler*

HEALTH EDUCATION

Consult PROFESSOR LLOYD M. JONES, M.A., Ph.D.

HEALTH ED. 501. HEALTH IMPLICATIONS IN THE GROWTH AND DEVELOPMENT OF SCHOOL CHILDREN (3).—New concepts of child growth; factors influencing growth and development of school children; medical inspection and examination; preschool program; early habit formations; mental hygiene; co-operation of parents, teachers, and children; educative programs. Prerequisite: Health Ed. 215.
Professor A. F. Davis

HEALTH ED. 505. ADVANCED TECHNIQUES IN HEALTH EDUCATION (3).—Prerequisites: Health Ed. 215, 399, Psy. 437. *Professor A. F. Davis*

HEALTH ED. 572. TESTS AND MEASUREMENTS IN HEALTH EDUCATION (3).—Critical study, evaluation, and demonstration of tests and measures of health education; statistical computations of data. Prerequisites: Phys. Ed. 490, Health Ed. 215, 399. *Professor F. J. Bedenk*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HEALTH ED. 403. FIRST AID, ATHLETIC CONDITIONING, AND TRAINING (3)
Professor S. P. Fogg

HEALTH ED. 405. RECENT DEVELOPMENTS IN PUBLIC HEALTH EDUCATION (3-6)
Professor A. F. Davis

HEALTH ED. 406. RECENT DEVELOPMENTS IN SCHOOL HEALTH EDUCATION (3) *Professor A. F. Davis*

HEALTH ED. 407, 407X. ADVANCED PERSONAL AND PUBLIC HEALTH (3) *Professor A. F. Davis*

HEALTH ED. 411. SAFETY EDUCATION IN THE SCHOOLS (3) *Professor C. D. Werner*

HEALTH ED. 427. HEALTH FACTORS IN THE DEVELOPMENT OF THE ADOLESCENT (3) *Professor A. F. Davis*

HEALTH ED. 453, 453X. ORGANIZATION AND ADMINISTRATION OF HEALTH EDUCATION (3) *Professor A. F. Davis*

HEALTH ED. 455S. RELATIONSHIPS OF HEALTH EDUCATION TO THE EXACT SCIENCES (3)

HEALTH ED. 456. ADVANCED TECHNIQUES IN RURAL SCHOOL HEALTH (3)

HISTORY

PROFESSOR J. PAUL SELSAM, M.A., Ph.D.
Head of the Department

HIST. 500. SEMINAR IN AMERICAN HISTORY (3-6).—Subject to be announced. *Professors W. H. Gray, B. M. Hermann, P. S. Klein*

HIST. 506. THE DIPLOMATIC BACKGROUND OF THE WORLD WAR, 1871 TO 1914 (3).—Prerequisites: Hist. 18, 19. *Professors J. E. Gillespie, J. P. Selsam*

HIST. 507. THE REFORM MOVEMENT IN MODERN ENGLAND, 1832 TO THE PRESENT (3) *Professors J. E. Gillespie, A. G. Pundt*

HIST. 508. STUDIES IN EUROPEAN HISTORY, 1600-1789 (3) *Professors J. P. Selsam, J. E. Gillespie*

HIST. 509. THE FRENCH REVOLUTION AND NAPOLEONIC ERA, 1789-1815 (3).—Prerequisites: Hist. 18, 19. *Professor J. E. Gillespie*

HIST. 511. SEMINAR IN EUROPEAN HISTORY (3-6) *Professors J. E. Gillespie, J. P. Selsam, A. G. Pundt*

HIST. 512. STUDIES IN PENNSYLVANIA HISTORY (3-6) *Professor P. S. Klein*

HIST. 515. STUDIES IN SOUTHERN HISTORY (3) *Professor P. S. Klein*

HIST. 520. THE AMERICAN REVOLUTION, 1763-1783 (3).—Prerequisites: Hist. 20, 21. *Professor B. M. Hermann*

HIST. 529. CULTURAL HISTORY OF THE EARLY MIDDLE AGES (3) *Professor J. H. Dahmus*

HIST. 532. STUDIES IN MEDIEVAL CIVILIZATION (3) *Professor J. H. Dahmus*

HIST. 533. STUDIES IN THE HISTORY OF THE UNITED STATES, 1829-1850 (3) *Professor P. S. Klein*

HIST. 534. THE CIVIL WAR AND RECONSTRUCTION, 1860-1877 (3).—Prerequisites: Hist. 20, 21. Recitation 3 hours. *Professors P. S. Klein, B. M. Hermann*

HIST. 536. STUDIES IN THE HISTORY OF THE UNITED STATES, 1877-1900 (3)

HIST. 538. STUDIES IN THE HISTORY OF FOREIGN RELATIONS OF THE UNITED STATES, 1492 TO THE PRESENT (3)

HIST. 562. SEMINAR IN LATIN-AMERICAN HISTORY (3-6).—Prerequisites: Hist. 22, 23. *Professor W. H. Gray*

HIST. 563. STUDIES IN THE HISTORY OF THE CARIBBEAN AREA (3).—Prerequisites: Hist. 22, 23. Lecture 3 hours. *Professor W. H. Gray*

HIST. 564. MEXICO IN THE 20TH CENTURY (3).—Prerequisites: Hist. 22, 23. Lecture 3 hours. *Professor W. H. Gray*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HIST. 405. HISTORICAL BACKGROUND OF AMERICAN POLITICAL PARTIES, 1607-1900 (3) *Professor J. G. Rayback*

HIST. 406. HISTORY OF AMERICAN LABOR (3) *Professor J. G. Rayback*

HIST. 418. THE AGE OF THE REFORMATION (3).—To alternate with Hist. 447. *Professor J. P. Selsam*

HIST. 419, 419X. RECENT EUROPEAN HISTORY (3) *Professors J. E. Gillespie, K. Forster*

HIST. 421, 421X. RECENT AMERICAN HISTORY (3) *Professors B. M. Hermann, K. Forster*

HIST. 422. HISTORY OF THE AMERICAN FRONTIER (3)

HIST. 423. THE FORMATIVE PERIOD OF AMERICAN HISTORY (3) *Professor P. S. Klein*

HIST. 437. THE MIDDLE AGES FROM CONSTANTINE TO THE CRUSADES (3) *Professor J. H. Dahmus*

HIST. 438. THE MIDDLE AGES FROM THE CRUSADES TO THE RENAISSANCE (3) *Professor J. H. Dahmus*

HIST. 441. RECENT AND CONTEMPORARY HISTORY OF GREAT BRITAIN (3)

HIST. 443. HISTORY OF MODERN RUSSIA (3) *Professor J. P. Selsam*

HIST. 444. EASTERN EUROPE IN MODERN TIMES (3) *Professor J. P. Selsam*

HIST. 445. THE AGE OF DISCOVERY (3) *Professor J. E. Gillespie*

HIST. 446. THE DEVELOPMENT OF THE BRITISH EMPIRE (3) *Professor J. E. Gillespie*

HIST. 447. ECONOMIC DEVELOPMENT OF MODERN EUROPE SINCE 1750 (3).—To alternate with Hist. 418. *Professor A. G. Pundt*

HIST. 448. SOCIAL AND CULTURAL HISTORY OF MODERN EUROPE (3) *Professor J. P. Selsam*

HIST. 450. ECONOMIC DEVELOPMENT OF COLONIAL AMERICA, 1607-1783 (3).—To alternate with Hist. 451. *Professor B. M. Hermann*

HIST. 451. SOCIAL AND CULTURAL HISTORY OF COLONIAL AMERICA, 1607-1783 (3).—To alternate with Hist. 450. *Professor B. M. Hermann*

HIST. 452. SOCIAL AND CULTURAL HISTORY OF THE UNITED STATES SINCE 1783 (3) *Dr. I. V. Brown*

HIST. 460. LATIN AMERICA AND THE UNITED STATES (3) *Professor W. H. Gray*

HIST. 461. SOCIAL AND CULTURAL HISTORY OF LATIN AMERICA (3).—To alternate with Hist. 460. *Professor W. H. Gray*

HOME ECONOMICS

PROFESSOR GRACE M. HENDERSON, M.S., Ph.D.
Dean of the School of Home Economics

HOME EC. 500. NUTRITION SEMINAR (3-6).—Selected topics and recent advances in nutrition. Prerequisite: Home Ec. 402. Recitation 3 to 6 hours.
Professor Ina Padgett

HOME EC. 501. INDIVIDUAL FOOD PROBLEMS (2-6).—Intensive study of specific problems in food preparation. Prerequisite: Home Ec. 434. Conference 1 hour, practicum 5 hours. *Professor G. M. Olson*

HOME EC. 502. PROBLEMS IN INSTITUTIONAL ADMINISTRATION (3-6).—Individual study of problems in institutional administration. Prerequisites: Home Ec. 310, 330, 426. Lecture 2 hours; practicum, individual field work.
Professor E. A. Atkinson

HOME EC. 503. DIET IN DISEASES (3).—Reports and discussions of the problems of adaptation of diet to disorders of nutrition. Prerequisites: Home Ec. 402. Lecture 3 hours. *Professor R. L. Pike*

HOME EC. 504. FIELD WORK IN NUTRITION (2-4).—Field problems planned to meet needs of individual students. Prerequisite: Home Ec. 402. Hours and problems to be arranged.

HOME EC. 505v. PRACTICUM IN TEACHING HOME ECONOMICS IN THE SECONDARY SCHOOL (3-6).—Projects in home economics education which may be carried out in the school in which the teacher is regularly employed. Conference and practicum hours to be arranged. *Professor J. D. Amberson*

HOME EC. 506, 506v, 506vX. CURRENT DEVELOPMENTS IN EDUCATION IN RELATION TO HOME ECONOMICS (3).—Opportunity for home economists to study newer developments in education. Prerequisite: one year of teaching experience in home economics. Lecture 3 hours. *Professor J. D. Amberson*

HOME EC. 507. RESEARCH IN HOME ECONOMICS (1-6 per semester).—Original studies in the field of student's major interest. Conference and practicum hours to be arranged.

HOME EC. 508. PARENTAL EDUCATION (3).—Discussion and use of methods, experiences, and programs which can be used effectively to help parents in dealing with problems of parent-child relationships. Prerequisites: Home Ec. 429, 430. Lecture 3 hours. *Professor W. L. Morgan*

HOME EC. 509v, 509vX. CURRICULUM WORKSHOP IN FAMILY LIFE EDUCATION (3).—Laboratory course in problems of curriculum building; individual problems in this field; frequent individual and group conferences. Prerequisite: one year's experience in teaching home economics.
Professor J. D. Amberson or H. M. Hatcher

HOME EC. 510v. THE SUPERVISION OF HOME ECONOMICS TEACHING (2-6).—For teachers of home economics desiring to qualify as city, county, or student teacher supervisors. Prerequisite: graduation from four-year teacher training curriculum and two years' teaching experience in home economics.
Professor J. D. Amberson, H. M. Hatcher, or M. E. Riegel

HOME EC. 511. PROBLEMS IN RELATION TO CLOTHING CONSUMPTION (3).—Problems connected with the manufacture and consumption of clothing, interrela-

tion of the textile and clothing trades with other industries. Prerequisite: Home Ec. 301. Lecture 3 hours. *Professor R. E. Graham*

Home Ec. 514. Economic and Nutritional Phases of Menu Planning (2-4).—Food expenditures in relation to nutritional value and income. Prerequisites: Home Ec. 402, Econ. 14. *Professor E. W. W. Dye*

Home Ec. 515, 515v, 515vX. The Teaching of Child Development and Family Relationships (3).—Methods of selection and presentation of subject matter basic to understanding the development of children, and the attitudes, emotions, and relationships within the family. Not open to students having credit for Home Ec. 482. Prerequisite: 6 credits in child development and family relationships. *Professor W. L. Morgan*

Home Ec. 516, 516v. Methods of Research in Home Economics (3).—Review of problems and techniques of research in home economics. Required of all graduate students in home economics. *Professor H. M. Hatcher*

Home Ec. 517. Thesis (1-15).—Conferences and assignments in connection with the preparation of the required thesis.

Home Ec. 518v. Evaluation in Family Life Education (3).—Methods of evaluating progress toward goals in home economics education and the use of findings in program planning and revision. *Professor H. M. Hatcher*

Home Ec. 519. Consumer Problems (2-3).—Methods of securing, evaluating, and presenting data concerning household commodities. Intended for those who teach home economics in high schools or colleges or who have charge of adult classes in this field.

Home Ec. 520. Techniques in Human Nutrition Research (3).—The more usual techniques employed by the research worker in human nutrition, accompanied by directed experience in their use and interpretation. Prerequisite or concurrent: Home Ec. 500. Lecture 2 hours, practicum 3 hours.

Home Ec. 521, 521v. Home Economics Education Seminar (2-3) Selected topics and recent developments in education for family living. Conferences and guidance relative to individual research problems. *Professor J. D. Amberson or H. M. Hatcher*

Home Ec. 522. Advanced Dress Design (3).—Draping of garments difficult in type and distinctive in design; survey of literature in dress design. Prerequisites: Art 56, Home Ec. 401. Conference 1 hour, practicum 5 hours.

Home Ec. 523. Advanced Fitting and Pattern Study (3).—Application of the principles involved in altering patterns and fitting garments to give students freedom in designing and ability to deal with difficult fitting problems. Prerequisite: Home Ec. 201. Lecture 1 hour, practicum 5 hours. *Professor M. E. Westgate*

Home Ec. 524. Economic Problems of the Household (3).—Economic problems of the present-day family; special emphasis upon factors in household production, use of money income, and standards of living. Prerequisites: Home Ec. 439, Econ. 14. Lecture 3 hours. *Professor M. B. Allgood*

Home Ec. 525, 525v. Home Economics and American Society (3).—Family life education in relation to a democratic culture; emphasis upon the interrelatedness of socioeconomic problems and the American family.

HOME EC. 526, 526v. THE COMMUNITY PROGRAM IN FAMILY LIFE EDUCATION (2-3).—Ways of discovering community needs and resources; methods in developing the community program in family living; leadership education for the lay member of the community. Recitation 2 or 3 hours.

HOME EC. 528. HOME MANAGEMENT SUPERVISION (2-3).—Evaluation of objectives and techniques in the organization, supervision, and teaching of the home management house experience. Prerequisite: Home Ec. 439. Recitation 2 or 3 hours. *Professor M. B. Allgood*

HOME EC. 530. SEMINAR IN FOODS (3-6).—Readings and reports on recent findings in food research.

HOME EC. 531, 531v. RESEARCH IN HOME ECONOMICS EDUCATION (1-6).—Investigation in home economics education. Individual conferences on research. *Professor J. D. Amberson or H. M. Hatcher*

HOME EC. 532, 532v. CURRICULUM IN FAMILY LIFE EDUCATION (3).—Planning the school-home-community curriculum in family living in the light of the immediate social, economic, and educational outlook.

HOME EC. 534. NUTRITION OF CHILDREN (3).—The nutritional needs of the normal child during prenatal life, infancy, and childhood. Prerequisites: Agr. Biochem. 35, Home Ec. 402. Lecture 3 hours. *Professor Ina Padgett*

HOME EC. 536. CHILDREN IN POSTWAR FAMILIES AND COMMUNITIES (3).—Postwar family and community situations influencing the development of children; the role of parents and teachers in helping individual children make satisfactory adjustments. Prerequisites: Home Ec. 429, 430, or 2 courses in psychology. Lecture 3 hours. *Professor W. L. Morgan*

HOME EC. 537. SPECIAL PROBLEMS IN CLOTHING AND TEXTILES (1-6).—Individual directed study, investigation, and practice in selected phases of textiles and clothing. Prerequisites: Home Ec. 102, 201. Lecture hours to be arranged.

HOME EC. 538. TAILORING (3).—The construction of tailored garments for women and children from new and renovated materials. Prerequisites: Home Ec. 102, 201. Lecture 1 hour, practicum 5 hours. *Professor M. E. Westgate*

HOME EC. 539. THE FASHION WORLD (3).—The development of fashion throughout the ages; relationship of present-day fashions and practices to previous periods. Prerequisites: Home Ec. 102, 301. Lecture 3 hours. *Professor R. E. Graham*

HOME EC. 540. SEMINAR IN CHILD DEVELOPMENT (1-6).—Readings and reports on recent findings in child development. Prerequisites: Home Ec. 429, 430, or Psy. 411 or 425. Lecture hours to be arranged. *Professor W. L. Morgan*

HOME EC. 541. ART IN THE ENVIRONMENT (3).—Approach based upon human needs with consideration of materials in the light of their use in home living. Prerequisite: Art 76 or Art Ed. 5 or Home Ec. 400. Lecture 2 hours, practicum 2 hours. *Professor A. G. Gardner*

HOME EC. 542. FOOD PROBLEMS (3).—Readings and discussion of selected food problems.

HOME EC. 543. HOME MANAGEMENT IN RELATION TO FAMILY LIVING (3).—Ways in which families manage; an opportunity to work with families in the solution of their management problems as a means of helping the student clarify her

thinking in relation to the entire field of family management. Prerequisite: 6 credits of home management or family economics courses in home economics.

Professor D. E. Wiesendanger

HOME EC. 544. SPECIAL PROBLEMS IN HOUSE MANAGEMENT (3).—Specific management problems, such as social, financial, and material, including the development of college level teaching aids. Prerequisite: 6 credits of home management or family economics courses in home economics.

HOME EC. 545, 545X. THE FAMILY IN ITS COMMUNITY (2-3).—Cultural influences on family relationships; how the family orients its members to community living and group participation. Prerequisites: Soc. 1, Home Ec. 405; Rur. Soc. 452 or Psy. 419. Lecture and recitation 2 or 3 hours.

Professor W. M. Smith Jr.

HOME EC. 546. SEMINAR IN FAMILY RELATIONSHIPS (1-3).—Reading, reports, and discussion of recent research in relationship aspects of family living; particular attention to studies of roles, crises, and adjustments within the family setting. Prerequisite: Home Ec. 405 or 6 hours of sociology or psychology. Lecture and recitation 1 to 3 hours. *Professor W. M. Smith Jr.*

HOME EC. 575. BACKGROUNDS OF THE HOME ARTS (3).—Art quality in the useful objects of today and of the past; comparison and evaluation of their form and function for the needs of their time; selections from industry and from hand arts leading to an exhibition. Prerequisites: Art 54 or Art Ed. 6, Art 74 or Home Ec. 220. Lecture 2 hours, practicum 2 hours. *Professor A. G. Gardner*

HOME EC. 585, 585X. CLOTHING INSTRUCTIONAL MATERIALS (3).—Preparation and evaluation of different types of materials for instruction in textiles and clothing. Prerequisite: Home Ec. 201. Lecture 1 hour, practicum 5 hours.

HOME EC. 590. GRADUATE SEMINAR IN HOME ECONOMICS (1).—Prerequisite: graduate standing. Discussion 1 hour. *Professor G. M. Henderson*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HOME EC. 400, 400X. HOME FURNISHING PROBLEMS (3)
Professor A. G. Gardner
HOME EC. 401. DRESS DESIGN (3)
HOME EC. 402. NUTRITION (4) *Professors Ina Padgett, R. L. Pike*
HOME EC. 403. THEORIES AND TECHNIQUES FOR COMMERCIAL DEMONSTRATORS (2)
HOME EC. 404, 404v. HOME FURNISHING TEACHING PROBLEMS (3)
HOME EC. 405. MARRIAGE AND FAMILY RELATIONSHIPS (3)
Professor M. S. McDowell
HOME EC. 406v. TEACHING AIDS IN FAMILY LIFE EDUCATION (1-4)
Professor M. E. Riegel
HOME EC. 408. EQUIPMENT FOR INSTITUTIONS (3)
HOME EC. 409. ELEMENTS OF DIET IN DISEASE (3) *Professor R. L. Pike*
HOME EC. 410. TEA ROOM MANAGEMENT (3)
HOME EC. 415v, 415vX. THE TEACHING OF HOMEMAKING (2)
HOME EC. 416v, 416vX. ADMINISTERING THE HOMEMAKING PROGRAM (2)
HOME EC. 423. ADVANCED HOME CRAFTS (2-12)
HOME EC. 426. INSTITUTION MARKETING (3)
HOME EC. 427, 427v, 427vX. FAMILY LIFE EDUCATION (3)
Professor M. E. Riegel

HOME EC. 429, 429X. CHILD DEVELOPMENT (3) *Professor D. J. Avery*
HOME EC. 430. OBSERVATION AND EXPERIENCE IN NURSERY SCHOOL (1-5)
HOME EC. 432. DIET THERAPY (3) *Professor Ina Padgett*
HOME EC. 434. EXPERIMENTAL COOKERY (1-6) *Professor G. M. Olson*
HOME EC. 437a,b,cS. SCHOOL CAFETERIA PROBLEMS (1-3).—Units A, B, C. 1 credit per unit.
HOME EC. 438. SCHOOL CAFETERIA (2-4)
HOME EC. 439. HOME MANAGEMENT (2) *Professor M. B. Allgood*
HOME EC. 440, 440X. STUDY OF LATER CHILDHOOD (3) *Professor D. J. Avery*
HOME EC. 441. NURSERY SCHOOL ORGANIZATION (3)
HOME EC. 442. RESIDENT EXPERIENCE IN HOME MANAGEMENT (3).—Room and board will be charged at regular rates.
HOME EC. 443, 443v, 443vX. ADULT HOMEMAKING EDUCATION (3) *Professor R. H. Cook*
HOME EC. 444. THE ART AND CRAFTS IN THE HOMEMAKING PROGRAM (3-6) *Professor A. G. Gardner*
HOME EC. 445. HOME MANAGEMENT EXPERIENCE (3)
HOME EC. 450. PROBLEMS IN HOUSEHOLD EQUIPMENT (1-6) *Professor M. B. Allgood*
HOME EC. 460, 460v, 460X, 460vX. RECENT FINDINGS IN HOME ECONOMICS (2-3)
HOME EC. 461. INSTITUTION ADMINISTRATION (3)
HOME EC. 462 INSTITUTION EXPERIENCE (3)
HOME EC. 463v. SENIOR SEMINAR (1)
HOME EC. 465v. STUDENT TEACHING (1-3)
HOME EC. 466v. STUDENT TEACHING (9)
HOME EC. 467. FOOD PRESERVATION (1-2)
HOME EC. 468. FAMILY NUTRITION (3) *Professor Ina Padgett*
HOME EC. 470. HOUSING THE FAMILY (2-3) *Professor D. E. Wiesendanger*
HOME EC. 472. CLOTHING CONSERVATION (2-3)
HOME EC. 473. HOME ARTS IN THE ADULT PROGRAM (3) *Professor A. G. Gardner*
HOME EC. 474, 474v. TEACHING HOME NURSING (1)
HOME EC. 475. TEACHING NUTRITION TO BOYS AND GIRLS (3)
HOME EC. 477. FAMILY MANAGEMENT (3)
HOME EC. 480. ADVANCED FOODS (3)
HOME EC. 481. EDUCATIONAL METHODS WITH PRESCHOOL CHILDREN (3)
HOME EC. 482. EDUCATION PROCEDURES IN CHILD DEVELOPMENT AND FAMILY RELATIONS (3) *Professor W. L. Morgan*
HOME EC. 484S. FASHION MERCHANDISING (3)

HORTICULTURE

PROFESSOR WARREN B. MACK, M.S., Ph.D., Sc.D.
Head of the Department

HORT. 500. ECOLOGY OF FRUIT PLANTS (3).—The factors limiting the distribution and intensity of culture of fruit species and varieties and the effect of environmental factors on cultural practices. Conference 3 hours.
Professor R. D. Anthony

HORT. 501. POMOLOGY RESEARCH (2-12).—Methods used in the more valuable research contributions to pomology. Prerequisite or concurrent: Hort. 445.
Professor R. D. Anthony

HORT. 503. EXPERIMENTAL PLANT BREEDING (3-6).—Problems based mainly on the research work of the department, with a review of experimental methods and literature. Prerequisite: Hort. 444. Conference. *Professor R. E. Larson*

HORT. 504. VEGETABLE GARDENING RESEARCH (2-12).—Minor phases of the research program of the department. Prerequisite or concurrent: Hort. 424.
Professor M. L. Odland

HORT. 506. NUTRITION OF FRUIT PLANTS (3-6).—The student is assigned a minor phase of the research work of the department. Conferences and reports.
Professor R. D. Anthony

HORT. 507. PLANT BREEDING RESEARCH (3-6).—A critical review of the breeding projects of the department, with original investigations. Prerequisite: Hort. 444. Conference and reports. *Professor R. E. Larson*

HORT. 508. NUTRITION OF VEGETABLE CROPS (3-6).—Research of the department, with original research on assigned problems. Conference and reports.
Professor W. B. Mack

HORT. 511. PROBLEMS IN FRUIT PROPAGATION (3-6).—The student is assigned minor phases of the department's research program in this field. Conference and reports. *Professor R. D. Anthony*

HORT. 512. FRUIT AND VEGETABLE STORAGE RESEARCH (2-4).—Problems in the construction and operation of common and refrigerated storage for fruits and vegetables. *Professor W. B. Mack*

HORT. 513. RESEARCH IN ORNAMENTAL HORTICULTURE (2-12).—A critical study of research in floriculture or nursery practice at this and other institutions, particularly the interpretation of results. Students are assigned minor phases of the research program of the department. *Professor E. I. Wilde*

HORT. 514. PROBLEMS IN THE PROPAGATION OF ORNAMENTAL PLANTS (3-6). —The effects of rooting media, temperature, age of wood, presence of leaves, and chemical stimuli upon the rooting response of cuttings; the optimum temperature for after-ripening and the germination of seeds; root stocks. *Professor R. P. Meahl*

HORT. 515. ECOLOGY OF ORNAMENTAL PLANTS (3).—The interrelation of ornamental plants and their environments, with emphasis on autecology.
Professor E. I. Wilde

HORT. 517. HORTICULTURE SEMINAR (1).—A review of current research publications in horticulture. Each student presents one or more reviews of assigned topics. Conference 1 hour weekly.

HORT. 518. RESEARCH PROBLEMS IN LANDSCAPE HORTICULTURE (3-12).— Selected problems to be assigned for original investigation in the creation, conservation, or management of planted areas. Prerequisite: Hort. 455. Lecture 2 hours, practicum hours variable. *Professor J. R. Bracken*

HORT. 519. SEMINAR ON THE GENETICS OF HORTICULTURAL CROPS (1 per semester).—Review of current research publications on the genetics of horticultural crops. Each student presents one or more reviews of literature on assigned topics. Conference 1 hour weekly.

HORT. 520. SEMINAR ON THE BREEDING OF HORTICULTURAL CROPS (1 per semester).—Each student presents one or more reviews of literature on assigned topics. Conference 1 hour weekly.

HORT. 521. TECHNICAL PRACTICES IN LANDSCAPE CONTRACTING (3-6).—Commercial and technical operations in landscape contracting and maintenance services. Prerequisites: Hort. 460, 461. *Professor J. R. Bracken*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HORT. 420. VEGETABLE CANNING CROPS (3) *Professor M. L. Odland*
HORT. 423. ADVANCED FRUIT AND VEGETABLE PROCESSING (3)
HORT. 424. PRINCIPLES OF OLERICULTURE (3-6) *Professor M. L. Odland*
HORT. 427. PRINCIPLES OF FLORICULTURE (3-6)
HORT. 444. ADVANCED PLANT BREEDING (3-6) *Professor R. E. Larson*
HORT. 445. PRINCIPLES OF POMOLOGY (3-9)
HORT. 453. NURSERY PRINCIPLES AND PRACTICE (3-6) *Professor R. P. Meahl*
HORT. 454. LANDSCAPE PLANTING DESIGN (3-6) *Professor J. R. Bracken*
HORT. 455. LANDSCAPE PLANTING DESIGN (3-6) *Professor J. R. Bracken*
HORT. 460. LANDSCAPE HORTICULTURE PROJECTS (3-6) *Professor J. R. Bracken*
HORT. 461. PARK, CEMETERY, AND INSTITUTIONAL GROUNDS ADMINISTRATION (3-6) *Professor J. R. Bracken*

HOTEL ADMINISTRATION

PROFESSOR GRACE M. HENDERSON, M.S., Ph.D.
Dean of the School of Home Economics
PROFESSOR ESTHER A. ATKINSON, M.S.

The following courses may be taken for graduate credit under the restrictions in force:

H. A. 415. HOTEL PROMOTION (2)
H. A. 440. HOTEL OPERATIONAL LIABILITIES (2)
H. A. 445. HOTEL ORGANIZATION AND OPERATION (3)

INDUSTRIAL EDUCATION

PROFESSOR S. LEWIS LAND, M.S., Ph.D.
Head of the Department

IND. ED. 501v. SEMINAR IN VOCATIONAL EDUCATION (1-12).—Conferences, investigations, and discussion for advanced students and mature persons who have had experience as teachers, supervisors, or administrators with one or more phases of vocational education. Conference 1 to 12 hours.

Unit A. Curriculum Construction (2-3)
Unit B. Testing and Grading (2-3)
Unit C. Vocational Technical Education (2-3)
Unit D. Adult Education (2-3)

IND. ED. 506v, 506vX. ADMINISTRATION OF VOCATIONAL EDUCATION (1-6).—The job of the local director of industrial education with major emphasis upon mat-

ters of vital importance in organizing and developing city and other local programs of industrial education. Prerequisite: 6 semester hours in industrial education or valid director's certificate, equivalent training and experience. Lecture 2 to 6 hours.

IND. ED. 510v, 510vX. VOCATIONAL EDUCATION FOR ADMINISTRATORS (2-3).—Designed for school administrators and supervisors who desire an understanding of the basic distinction between practical arts education and vocational education; and who wish to familiarize themselves with the underlying principles, essential philosophy, valid objectives, and accepted methods effective in organizing, supervising, and administering vocational education programs. Prerequisite: Ind. Ed. 1v or trade or teaching experience. Lecture 2 hours.

IND. ED. 550v. RESEARCH IN VOCATIONAL EDUCATION (1-12).—Research techniques in vocational education and research problems in connection with work of evening, part-time, or day vocational industrial schools.

Unit A. Research Techniques in Vocational Industrial Education (2-3)

Unit B. Individual Research Problems in Vocational Industrial Education (1-10)

IND. ED. 555v, 555vX. CURRENT PROBLEMS IN VOCATIONAL EDUCATION (1-6).—Recent trends and developments in part-time, full-time, and evening school education, involving critical analysis of objectives, content, and outcome, together with constructive suggestions for improving current practice where possible. Lecture 3 to 6 hours.

Unit A. Changing Industrial, Economic, and Social Conditions (1)

Unit B. Policies and Program of the American Vocational Association (1)

Unit C. Federal and State Vocational Legislation, Present and Pending (1)

Unit D. Financing Vocational Education (1)

Unit E. Current Administrative Problems in Vocational Education (1)

Unit F. Current Administrative Problems in Vocational Education (continued) (1)

IND. ED. 558v. FRONTIER PROBLEMS IN VOCATIONAL INDUSTRIAL EDUCATION (2-3 per unit)

Unit A. Federal Legislation (2-3)

Unit B. Present-Day Local Personnel and Curriculum Problems (2-3)

Unit C. State and Local Supervision and Administration (2-3)

IND. ED. 560v, 560vX. PHILOSOPHY OF INDUSTRIAL EDUCATION (2-3).—Principles and beliefs upon which progressive industrial education rests; basic concepts underlying practical arts and vocational education; literature for evaluating instructional practices in industrial education. Prerequisite: 12 hours in industrial education or teaching experience.

IND. ED. 574. HISTORY AND PHILOSOPHY OF INDUSTRIAL ARTS (2-3).—Historical developments and concurrent educational philosophies of industrial arts in American education. Prerequisite: 12 hours in professional courses in industrial education or teaching experience. Lecture 2 or 3 hours.

IND. ED. 575, 575X. PROBLEMS IN INDUSTRIAL ARTS EDUCATION (2-3).—Group and individual investigations and class discussions of teaching problems of industrial arts in such areas as departmental and subject objectives, subject matter, projects, methods of manual and informational teaching, aids and devices, selection

of text and reference materials, personnel organization, shop management, problem pupils, etc. Prerequisite: 12 hours of industrial education.

IND. ED. 576. SUPERVISION AND ADMINISTRATION OF INDUSTRIAL ARTS EDUCATION (2-3).—How to organize, supervise, and administer functioning programs of industrial arts; the duties of a supervisor and director of industrial arts; special problems of supervision and administration of industrial arts; relationships to local, state, and federal educational authorities; correlating industrial arts with other areas of learning. Lecture 2 or 3 hours.

IND. ED. 577. TESTING IN INDUSTRIAL ARTS (2-3).—Construction of informal manipulative and written tests; use of standardized mechanical aptitude and achievement tests; construction and use of rating scales; scoring and grading; interpretation of test results. Prerequisites: 6 hours in graduate courses in industrial arts and a graduate course in psychology. Lecture 2 or 3 hours.

IND. ED. 578. RESEARCH IN INDUSTRIAL ARTS (1-18).—Individual research in industrial arts for dissertations and lesser research studies. Prerequisite: 6 hours in professional courses in industrial arts.

Unit A. Common Research Techniques in Industrial Arts (2-3)

Unit B. Individual Research Problems in Industrial Arts (1-15)

IND. ED. 579. MASTER'S THESIS IN INDUSTRIAL ARTS (1-6).—Conferences and assignments relating to the preparation of an acceptable thesis in industrial arts for the Master of Science or Master of Education degrees. Prerequisite: 6 hours in professional courses in industrial arts.

IND. ED. 580. SEMINAR IN INDUSTRIAL ARTS (2-9).—Directed study, investigation, or research in study of selected specific fields of industrial arts. Reports and constructive criticism. Primarily for graduate students majoring in industrial arts education. Prerequisite: 12 hours in industrial education or teaching experience. Lecture 2 to 9 hours.

IND. ED. 590v. MASTER'S THESIS IN INDUSTRIAL EDUCATION (2-6).—Conferences and assignments relating to the selection and preparation of an acceptable thesis for the degree of Master of Education or Master of Science.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

IND. ED. 401v, 401vX. HISTORY OF INDUSTRIAL EDUCATION (2-3)
IND. ED. 402v, 402vX. SUPERVISION OF VOCATIONAL EDUCATION (2-3)
IND. ED. 403v, 403vX. SUPERVISED FIELD WORK (1-6)
IND. ED. 405v, 405vX. CONFERENCE LEADER TRAINING (2-3)
IND. ED. 407, 407X. INDUSTRIAL ARTS EDUCATION (2-3)
IND. ED. 408v, 408vX. OCCUPATIONS (2-3)
IND. ED. 409v, 409vX. TESTS AND MEASUREMENTS (2-3)
IND. ED. 410v, 410vX. INFLUENCES OF MODERN INDUSTRIAL LIFE ON INDUSTRIAL EDUCATION (2-3)
IND. ED. 412v, 412vX. SPECIAL PROBLEMS IN VOCATIONAL EDUCATION (2-4)
IND. ED. 414v, 414vX. VOCATIONAL EDUCATIONAL GUIDANCE (2-3)
IND. ED. 415v, 415vX. PROBLEMS IN CO-ORDINATING VOCATIONAL EDUCATION (2-3)
IND. ED. 418v, 418vX. PROBLEMS IN AUDIO-VISUAL AIDS IN INDUSTRIAL EDUCATION (2-3)
IND. ED. 420v, 420vX. OCCUPATIONAL HYGIENE (2-3)
IND. ED. 421, 421X. CURRICULUM MATERIALS IN INDUSTRIAL ARTS (2-3)

IND. ED. 427v, 427vX. ADVANCED COURSE OF STUDY BUILDING (2-3)
IND. ED. 430v, 430vX. SAFETY EDUCATION FOR VOCATIONAL TEACHERS (2-3)
IND. ED. 436v, 436vX. ADULT EDUCATION IN INDUSTRIAL AMERICA (2-3)
IND. ED. 446v, 446vX. IMPROVEMENT OF INSTRUCTION IN VOCATIONAL EDUCATION (2-4)
IND. ED. 450v, 450vX. SHOP LAYOUT AND MANAGEMENT (2-3)
IND. ED. 458v. EMERGING PROBLEMS IN VOCATIONAL EDUCATION (1-7)
IND. ED. 460. PROBLEMS IN VOCATIONAL REHABILITATION OF THE HANDICAPPED (1-6)
Unit A. The Counseling Interview in Vocational Rehabilitation (1-3)
Unit B. Occupational Information and Placement Techniques in Vocational Rehabilitation (1-3)
IND. ED. 470, 470X. PROBLEMS IN SENIOR HIGH SCHOOL INDUSTRIAL ARTS (2-3)

INDUSTRIAL ENGINEERING

PROFESSOR CLARENCE E. BULLINGER, I.E., M.S.
Head of the Department

I.E. 501. MANUFACTURING METHODS (2-8).—Special projects including investigation, experimentation, design, and research of some one or more special types of manufacture. Seminar and practicum. *Professor C. E. Bullinger*

I.E. 502. MANAGEMENT METHODS (3-6).—Intensive study of the newer phases of scientific management, including production control and application of Gantt charts; research on special problems. Seminar and practicum.
Professor C. E. Bullinger

I.E. 503. PERSONNEL RELATIONS (2-8).—Research on special topics. Seminar.
Professor C. E. Bullinger

I.E. 505. GRAPHICAL COMPUTATION (2-10).—The construction of natural and logarithmic scales, applications of various co-ordinate papers and construction of nomographic or alignment charts; determination of empirical formulae from engineering data. Seminar and practicum. *Professor M. M. Babcock*

I.E. 506. TIME AND MOTION STUDY (3-9).—Machine data, elementary and fundamental machine times; determination of fatigue curves; design of Barth slide rules, micromotion study and chart plotting of micromotion results; chronocyclegraph study. Seminar. *Professor C. A. Anderson*

I.E. 507. BUDGETARY CONTROL AND STANDARD COSTS (3-6).—The principles involved in the preparation of budgets by functional divisions and the application of divisional budgets as control media; the principles involved in establishing standard cost data, standard cost accounting procedures, and the use of cost variances in controlling manufacturing operations. Prerequisite: I. E. 401. Seminar.
Professor R. A. Hussey

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

I.E. 401. INDUSTRIAL ACCOUNTS (4) *Professor R. A. Hussey*
I.E. 404. SCIENTIFIC MANAGEMENT (2) *Professor C. E. Bullinger*
I.E. 406. FACTORY PLANNING (2) *Professor M. M. Babcock*
I.E. 409. PERSONNEL ADMINISTRATION (3) *Professor G. D. Thomas*

I.E. 411. Manufacturing Budgets (2) *Professor R. A. Hussey*
I.E. 422a,b,c,d,e,f. Industrial Engineering Problems (2 per unit)
Professors M. M. Babcock, C. E. Bullinger, C. A. Anderson, R. A. Hussey, G. D. Thomas
I.E. 423. Quality Control (2-3) *Professor C. E. Bullinger*

JOURNALISM

Professor Franklin C. Banner, M.A.
Head of the Department

The following course may be taken for graduate credit under the restrictions in force:
Journ. 430S. Supervision and Management of School Publications (3)

LATIN

Professor Robert E. Dengler, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

Latin 500. Latin Literature (3).—Lectures and collateral readings on the major forms of Latin literature; readings in the original Latin to supplement the lectures. *Professor R. E. Dengler*

Latin 501. Roman Religion and Philosophy (3).—Primitive Roman religious concepts; their growth through contact with more mature cultures; the development of philosophic thought at Rome; the social and political status of society in the Roman empire in relation to the rise of Christianity. Lectures and reports. *Professor F. B. Krauss*

Latin 502. Latin Epigraphy (3).—Lectures and readings on Roman inscriptions; illustrative exercises. *Professor F. B. Krauss*

Latin 503. Latin Paleography (3).—The Latin alphabet, writing materials, Roman book and cursive hands; illustrative exercises. *Professor R. E. Dengler*

Latin 504. Roman Topography (3).—The physical development of the city of Rome, its walls, aqueducts, bridges, streets, fora, public buildings, temples, etc.; building materials and methods of construction. Lectures and reports. *Professor F. B. Krauss*

Latin 510. Latin Seminar (3)

Latin 518. Latin Research (1-3).—Prosecution of an assigned problem under the guidance of a member of the department. *Professor R. E. Dengler*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:
Latin 428. Lucretius (3) *Professor F. B. Krauss*
Latin 429. Quintilian (3) *Professor F. B. Krauss*
Latin 431. Juvenal (3) *Professor F. B. Krauss*
Latin 436S. Functional Problems in Latin (3)
Latin 440a,b,c,dS. College Latin (3-12) *Professor R. E. Dengler*

LIBRARY SCIENCE

Consult Librarian Ralph W. McComb, M.A.

The following courses may be taken for graduate credit under the restrictions in force:

Lib. Sci. 403S. Intermediate Dictionary Cataloguing and Subject Headings (2-3)

Lib. Sci. 405S. Intermediate Reference Work and Bibliography (2-3)

MATHEMATICS

Professor Frederick W. Owens, M.S., Ph.D.
Head of the Department

Math. 500. Analytical Mechanics (3).—An exposition of rigid dynamics, the potential function, and Lagrange's equations. Prerequisite: Math: 419. Lecture 3 hours.

Math. 501. Theory of Functions of a Real Variable (3).—Theory of point sets; of continuous and discontinuous functions of a real variable, together with the study of their derivatives and of their integrals in both the Riemann and Lebesgue sense. Prerequisite: Math. 421. Lecture 3 hours.

Math. 502. Theory of Functions of a Real Variable (3).—Continuation of Math. 501. Lecture 3 hours.

Math. 503. Fourier Series and Harmonic Functions (3).—Fourier series and integrals; spherical harmonics, Bessel functions, etc., with special emphasis on their applications. Prerequisite: Math. 431.

Math. 505. Integral Equations and Their Application to Mathematical Physics (2).—The solution of the equations of Fredholm and Volterra, together with their application to problems of geometry and analysis, to boundary problems in physics, etc. Prerequisite: Math. 405. Lecture 2 hours.

Math. 506. Integral Equations and Their Application to Mathematical Physics (2).—Continuation of Math. 505. Lecture 2 hours.

Math. 507. Calculus of Variations (3).—Prerequisites: Math. 421, 431. Lecture 3 hours.

Math. 508. Theory of Functions of a Complex Variable (3).—A logical development of the complex number system and the fundamental operations of complex numbers; the theory of analytic functions of a complex variable. Prerequisites: Math. 9, 11. Lecture and exercises 3 hours.

Math. 509. Theory of Functions of a Complex Variable (3).—Continuation of Math. 508. Lecture and exercises 3 hours.

Math. 510. Theory of Substitution Groups (2).—The application of the theory of algebraic equations. Lecture 2 hours.

Math. 511. Introduction to Higher Algebra (3).—Algebra of matrices, determinants, bilinear and quadratic forms. Prerequisites: Math 9, 11. Lecture and exercises 3 hours.

Math. 512. Introduction to Higher Algebra (3).—Continuation of Math. 511. Lecture and exercises 3 hours.

MATH. 513. ADVANCED ANALYTIC GEOMETRY (3).—Introduction of homogeneous co-ordinates and their use in the study of projective properties. Prerequisite: Math. 30.

MATH. 514. ADVANCED ANALYTIC GEOMETRY (3).—Continuation of Math. 513.

MATH. 520. PROJECTIVE GEOMETRY (3).—A general study of the subject from the postulational standpoint. Prerequisite: Math. 30. Lecture 3 hours. Alternate years or as required.

MATH. 521. PROJECTIVE GEOMETRY (3).—Continuation of Math. 520. Lecture 3 hours. Alternate years or as required.

MATH. 522. METRIC DIFFERENTIAL GEOMETRY (3).—The usual classical treatment of the subject. Prerequisite: Math. 11 or 30.

MATH. 523. DIFFERENTIAL GEOMETRY (3).—Continuation of Math. 522.

MATH. 524. PROJECTIVE DIFFERENTIAL GEOMETRY (3).—Study of the classic methods of Wilcznski, Lane, Fubini, etc. Prerequisite: Math. 514. Lecture 3 hours.

MATH. 525. PROJECTIVE DIFFERENTIAL GEOMETRY (3).—Continuation of Math. 524. Lecture 3 hours.

MATH. 526. ALGEBRAIC GEOMETRY (3).—Involutions on rational curves and related topics. Prerequisite: Math 514. Lecture 3 hours.

MATH. 527. ALGEBRAIC GEOMETRY (3).—Continuation of Math. 526. Lecture 3 hours.

MATH. 530. ANALYSIS SITUS (3).—Combinatorial analysis situs with application, abstract spaces, continuous curves, and the theory of dimensionality. Prerequisite: Math. 501.

MATH. 531. ANALYSIS SITUS (3).—Continuation of Math. 530.

MATH. 532. THEORY OF SETS (3).—Theory of abstract sets; cardinal and ordinal numbers; sets of points in Euclidean space and in general metric space; theory of measure with applications to geometry and function theory. Prerequisite: general mathematical maturity. Lecture 3 hours.

MATH. 533. THEORY OF SETS (3).—Continuation of Math. 532. Prerequisite: Math. 532. Lecture 3 hours.

MATH. 534. THEORY OF ALGEBRAIC NUMBERS (3).—An introduction to the number theory of quadratic fields, with a study of the theory of ideals in quadratic and higher fields, with application. Prerequisite: Math. 504.

MATH. 535. MODERN ALGEBRAIC THEORIES (3).—Algebraic invariants, matrices, quadratic and Hermitian forms, Galois theory of equations, modular systems, etc. Prerequisite: general mathematical maturity. Lecture 3 hours.

MATH. 536. MODERN ALGEBRAIC THEORIES (3).—Continuation of Math. 535. Lecture 3 hours.

MATH. 540. THEORY OF RELATIVITY (3).—An introduction to the subject by a study of the Riemann Einstein space. Prerequisites: Math. 405, 417, 431.

MATH. 541. THEORY OF RELATIVITY (3).—Continuation of Math. 540.

MATH. 550. MATHEMATICAL LOGIC (3).—The logical basis of mathematics and its ultimate nature. Prerequisite: general mathematical maturity. Lecture 3 hours.

MATH. 560. THEORY OF DIFFERENTIAL EQUATIONS (3)

MATH. 561. THEORY OF DIFFERENTIAL EQUATIONS (3).—Continuation of Math. 560.

MATH. 570. SPECIAL TOPICS IN GEOMETRY (3-6)

MATH. 571. SPECIAL TOPICS IN ANALYSIS (3-6)

MATH. 575. MATHEMATICS SEMINAR (2-6).—Selected topics from recent mathematical developments. Prerequisite: general mathematical maturity. Lecture 2 hours.

MATH. 576. MATHEMATICS SEMINAR (2-6).—Continuation of Math. 575. Lecture 2 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MATH. 401. COLLEGE GEOMETRY (3)
MATH. 403. MODERN METHODS IN GEOMETRY (3)
MATH. 404. THEORY OF NUMBERS (3)
MATH. 405. PARTIAL DIFFERENTIAL EQUATIONS (3)
MATH. 409. THEORY OF PROBABILITY (3)
MATH. 410. STATISTICAL METHODS (3)
MATH. 411. FINITE DIFFERENCES (3)
MATH. 417. VECTOR ANALYSIS (3)
MATH. 419. ANALYTICAL MECHANICS (3)
MATH. 420. ADVANCED CALCULUS (3)
MATH. 421. ADVANCED CALCULUS (3)
MATH. 424. LEAST SQUARES (2)
MATH. 425. CURVE FITTING (1)
MATH. 431. DIFFERENTIAL EQUATIONS (3)
MATH. 440. THEORY OF EQUATIONS (3)
MATH. 441. THEORY OF EQUATIONS (3)
MATH. 451. INTRODUCTION TO APPLIED MATHEMATICS (3-6)
MATH. 452. INTRODUCTION TO APPLIED MATHEMATICS (3-6)
MATH. 471. FOUNDATIONS OF ALGEBRA (3)
MATH. 472. FOUNDATIONS OF GEOMETRY (3)

MECHANICAL ENGINEERING

PROFESSOR NORMAN R. SPARKS, M.E.

Head of the Department

M.E. 502. ADVANCED GAS TURBINES (3-6).—The thermodynamic and stress analysis design of gas turbine and compressor units. Prerequisite: M.E. 409.

M.E. 504. ADVANCED THERMODYNAMICS (3-6).—Pure and applied thermodynamics including its application to advanced engineering problems; collateral reading and discussion of the classical works on the subject. Prerequisite: M.E. 3 or 104.

M.E. 505. HEAT TRANSMISSION (3-6).—Applications of principles of heat transfer to efficient design of mechanical engineering equipment. Prerequisite: M.E. 412.

M.E. 506. MECHANICAL ENGINEERING SEMINAR (1-4).—Advanced courses adapted to the individual requirements of graduates in mechanical engineering. Prerequisites: M.E. 107, 410.

M.E. 507. Advanced Internal Combustion Engines (3).—Design and performance of both carburetor and fuel injection type reciprocating engines primarily from the thermodynamic viewpoint, with emphasis on the economics of operation. Prerequisites: M.E. 413, 504. Lecture 3 hours.

M.E. 508. Mechanical Engineering Research (1-9).—Research related to the mechanical engineering major subject; work must show evidence of original thinking; may be scheduled as thesis work for the M.S. degree.

M.E. 509. Heat Engineering Seminar (2-6).—Advanced studies in design and performance of heat equipment, direct-fired and unfired; adapted to the individual requirements of graduates in mechanical engineering. Prerequisite: M.E. 6.

MECHANICAL ENGINEERING DESIGN

M.E. Des. 502. Friction and Lubrication (3).—The hydrodynamic theory of lubrication, and the methods of applying it to bearing design, together with a survey of methods of testing lubricants.

M.E. Des. 505. Advanced Dynamics of Machines (3-6).—Linear and torsional vibrations in and balancing of rotating and reciprocating machinery; an exact analysis of the stresses produced by these and other dynamic forces in machine parts. Prerequisites: Mchs. 12, M.E. Des. 8.

MECHANICAL ENGINEERING LABORATORY

M.E. Lab. 501. Investigation Projects (2-6).—Special experimental studies or investigations in mechanical engineering, adapted to individual requirements.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

M.E. 401a,b,c,d. Mechanical Engineering (3-12)
M.E. 402. Air Conditioning (3)
M.E. 408. Steam Turbines (3)
M.E. 409. Gas Turbines (3)
M.E. 410. Steam Power Plants (2-4)
M.E. 411. Refrigeration (2-4)
M.E. 412. Fundamentals of Heat Transfer (3)
M.E. 413. Internal Combustion Engines (2-4)
M.E. 415. Heat Transfer Processes in Commercial Manufacturing (3)
M.E. 416. Resistance and Powering of Ships (3)
M.E. Des. 402. Design of Machine Tools (3)

METALLURGY

Professor Harold J. Read, M.S., Ph.D.
Acting Chief of the Division

Met. 500. Metallurgical Research (3-15 per semester).—Research on special topics; conferences, reading, and library work. Results may be embodied in a thesis. Prerequisites: Met. 411, 413.

Met. 501. Metallurgical Problems (1-6 per semester).—Independent study of special problems in metallurgy. Prerequisites: Met. 411, 413. Practicum 3 to 18 hours.

MET. 502. METALLURGICAL SEMINAR (1 per semester).—Conferences, reading, and reports. Required of all graduate students in metallurgy.

MET. 515. CORROSION AND PROTECTION OF METALLIC SURFACES (3).—The phenomena and theories of corrosion processes from the viewpoint of the metallurgist; the chemistry and metallurgy of metal protection by electroplating, anodizing, galvanizing, tinning, metal spraying, and other metallurgical surface treatments, in both theoretical and practical aspects. Prerequisites: Met. 411, 413. Lecture 3 hours.
Professor H. J. Read

MET. 516. MECHANICAL METALLURGY (3).—Theory of plastic flow and rupture of polycrystalline metals; the influence of combined stresses, rate of deformation and temperature variation on the flow and rupture of metals; the applications of theory to metal forming operations and the interpretation of mechanical test results. Prerequisites: Met. 411, 413. Lecture 3 hours.

MET. 517. ADVANCED NONFERROUS METALLURGY (3).—Theory of chemical processes in the extractive metallurgy of the principal nonferrous metals; particular attention to electrometallurgical operations in the fields of electrowinning and electrorefining, and to processes involving the vapor phase. Prerequisites: Met. 411, 413. Lecture 3 hours.
Professor H. J. Read

MET. 518. CONSTITUTION OF METALLURGICAL SYSTEMS (3).—Application of thermodynamic principles to the study of gas-metal, slag-metal, and complex alloy systems; equilibrium and rates of reaction in metal extractions and refining processes. Constitution of complex alloys. Prerequisites: Met. 411, 413. Lecture 3 hours.
Professor H. M. Davis

MET. 519. ADVANCED FERROUS METALLURGY (3).—Theory of the chemical processes in the smelting, refining, and deoxidation of iron and steel; slag and metal bath control methods; ingot solidification and primary forging operations, and their relation to the properties of wrought steel products. Prerequisites: Met. 411, 413. Lecture 3 hours.

MET. 520. FOUNDRY METALLURGY (3).—The principles of foundry metallurgy and their application to foundry operations for various casting alloys; specific attention to steels, cast irons, and the nonferrous metals with respect to the metallurgy and operations involved in their founding. Prerequisites: Met. 411, 413. Lecture 3 hours.
Professor R. W. Lindsay

MET. 521. ENGINEERING ALLOYS (3).—Ferrous and nonferrous alloys used for special purposes such as tool steels, electrical sheets, and corrosion and heat-resisting alloys; the various alloys available for each application are compared on the basis of properties and relative cost; discussion based upon the metallography and constitution of the particular alloy systems involved. Prerequisites: Met. 411, 413. Lecture 3 hours.
Professor R. W. Lindsay

MET. 522. SOLID PHASE REACTIONS IN METALS (3).—Mechanism and rate determining factors in solid phase reactions in metals; diffusion processes, nucleation theory, precipitation from solid solution, eutectoid, decomposition and order-disorder phenomena. Prerequisites: Met. 411, 413. Lecture 3 hours.
Professor E. P. Klier

MET. 523. BEHAVIOR OF METAL CRYSTALS (3).—Plastic action in single crystals of metals and in polycrystalline metals, theoretical crystal plasticity, recovery, and recrystallization, deformation and recrystallization textures, anistropy in general. Prerequisites: Met. 411, 413. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MET. 405. FERROUS METALLOGRAPHY (3)
MET. 406. NONFERROUS METALLOGRAPHY (3)
MET. 407. METALLURGICAL ENGINEERING I (3)
MET. 408. METALLURGICAL ENGINEERING II (3)
MET. 409. METALLURGICAL INVESTIGATIONS I (3)
MET. 410. METALLURGICAL INVESTIGATIONS II (3)
MET. 411. ADVANCED PHYSICAL METALLURGY (3)
MET. 412. EXPERIMENTAL METALLURGY (3)
MET. 413. ADVANCED CHEMICAL METALLURGY (3)

METEOROLOGY

PROFESSOR HANS H. NEUBERGER, D.Sc.
Chief of the Division

METEOR. 500. METEOROLOGICAL SEMINAR (1-3).—Discussion of meteorological reports and papers; scientific outlook. Prerequisites: Meteor. 421, 441, 451. Lecture 1 to 3 hours.

METEOR. 501. METEOROLOGICAL RESEARCH (3-15).—Research work in physical, synoptic, dynamic meteorology; climatology. Prerequisites: a minimum of one year of physics, calculus, and differential equations, 15 credits in meteorology. Practicum 3 hours per credit.

METEOR. 502. SELECTED TOPICS OF ADVANCED METEOROLOGY (2).—Lectures, review, and discussion of current problems in meteorology. Prerequisite: a minimum of 15 credits in meteorology. Lecture 2 hours.

METEOR. 504. THEORETICAL AND DYNAMIC METEOROLOGY (3).—Mathematical analysis of meteorological phenomena; theory of circulation; deformation fields. Prerequisite: Meteor. 452. Lecture 3 hours.

METEOR. 505. BIOCLIMATOLOGY (2).—Climatic phenomena in their relation to life. Prerequisite: Meteor. 372. Lecture 2 hours.

METEOR. 506. ADVANCED METEOROLOGICAL ANALYSIS (2-6).—Physical analysis of atmospheric phenomena; synoptic analysis of weather phenomena for advanced students. Prerequisite: Meteor. 421. Lecture 1 hour, practicum 3 to 15 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

METEOR. 421. SYNOPTIC METEOROLOGY I (3)
METEOR. 422. SYNOPTIC METEOROLOGY II (3)
METEOR. 431. SYNOPTIC METEOROLOGY LABORATORY I (2)
METEOR. 432. SYNOPTIC METEOROLOGY LABORATORY II (2-10)
METEOR. 441. PHYSICAL METEOROLOGY I (2)
METEOR. 442. PHYSICAL METEOROLOGY II (2)
METEOR. 451. DYNAMIC METEOROLOGY I (3)
METEOR. 452. DYNAMIC METEOROLOGY II (3)
METEOR. 453. PROBLEMS IN DYNAMIC METEOROLOGY (1)
METEOR. 492. METEOROLOGICAL SEMINAR (2)

MINERAL ECONOMICS

Professor W. M. Myers, M.S., Ph.D.
Chief of the Division

Min. Econ. 500. Marketing of Minerals and Mineral Products (3-6).—Research in mineral marketing problems. Prerequisite: Min. Econ. 453.
Professor W. M. Myers

Min. Econ. 501. Research in Mineral Economics (3-6).—Investigation in specialized fields of research in mineral economics. Prerequisite: Min. Econ. 453.
Professor W. M. Myers

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Min. Econ. 400. Seminar (1) *Professor W. M. Myers*
Min. Econ. 453. Nonmetallic Minerals (3) *Professor W. M. Myers*
Min. Econ. 483. The Metals and Their Ores (3) *Professor W. M. Myers*
Min. Econ. 484. The Fuels (3) *Professor W. M. Myers*

MINERAL PREPARATION

Professor Raymond E. Zimmerman, E.M.
Chief of the Division

Min. Prep. 502. Froth Flotation and Agglomeration (3).—An intensive study of the theory and applications of froth flotation and agglomeration. Prerequisite: Min. Prep. 405. Lecture 3 hours. *Professor S. C. Sun*

Min. Prep. 504. Mineral Preparation Research (3-10).—Research work on specific problems in mineral preparation. Prerequisite: Min. Prep. 405 or 410. Practicum 9 to 30 hours.

Min. Prep. 505. Gravity Processes and Miscellaneous Methods of Mineral Preparation (3).—An intensive study of the theory and applications of gravity, magnetic, electrostatic, centrifugal, and dense-media processes of mineral concentration. Prerequisite: Min. Prep. 405. Lecture 3 hours.

Min. Prep. 506. Mineral Preparation Plant Design (3-10).—The layout, design, and selection of equipment for specific mineral preparation plant projects. Prerequisite: Min. Prep. 405. Practicum 9 to 30 hours.
Professor D. R. Mitchell

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Min. Prep. 400. Mineral Preparation Seminar (1)
Min. Prep. 403. Flowsheets of Mineral Preparation Plants (2)
Min. Prep. 404. Plant Layout and Design (2)
Min. Prep. 405. Unit Operations (4)
Min. Prep. 406. Mineral Preparation Testing (2)
Min. Prep. 410. Coal Preparation (3) *Professor D. R. Mitchell*

MINERALOGY

PROFESSOR PAUL D. KRYNINE, Ph.D.
Chief of the Division

MIN. 500. PHYSICAL MINERALOGY (3).—Optical methods and measurement of optical constants of minerals. Seminar 1 hour, practicum 6 hours.
Professors P. D. Krynine, T. F. Bates

MIN. 501a. PETROLOGY (3-6).—Microscopic study of rocks, emphasizing classification and genetic relationships. Seminar and practicum.
Professors P. D. Krynine, E. F. Osborn, J. C. Griffiths

*MIN. 502a. MINERALOGICAL RESEARCH (3-18).—An original study of some mineralogical problem, results of which may be applied on the thesis requirements.

MIN. 503. SEDIMENTARY PETROGRAPHY (3).—Application of the more refined methods of mechanical and microscopic analyses to the interpretation of difficult sedimentary rocks and to problems of industrial petrography. Prerequisite: Min. 485. Lecture 1 hour, practicum 6 hours. *Professors P. D. Krynine, J. C. Griffiths*

MIN. 504. THEORETICAL MINERALOGY (3).—Selected topics in crystal chemistry and crystal physics applied to solid solution, polymorphism, crystal growth, and related phenomena; laboratory studies of identification techniques including X-ray diffraction. Prerequisite: Min. 31. Lecture 2 hours, practicum 3 hours.
Professor T. F. Bates

†MIN. 505. MINERALOGY SEMINAR (1-2).—Reading, presentation, and discussion of literature dealing with various phases of theoretical mineralogy. Topics are selected to meet the interests of the majority of the students. Lecture 1 hour.
Professors P. D. Krynine, E. F. Osborn, T. F. Bates, J. C. Griffiths

‡MIN. 507. PHYSICOCHEMICAL PETROGRAPHY (2-3).—Advanced work in the constitution and phase relations of inorganic crystals and liquids; special emphasis on silicate compounds and glasses. Prerequisite: Min. 483. Lecture 2 hours, practicum 3 hours. *Professor E. F. Osborn*

‡MIN. 508. PHYSICOCHEMICAL PETROLOGY (2-3).—Application of the principles of physicochemical petrography to the origin of igneous and metamorphic rocks. Prerequisite: Min. 507. Lecture 2 hours, practicum 3 hours.
Professor E. F. Osborn

§MIN. 510. METAMORPHISM (2-6).—A detailed review of chemical mineralogical and structural changes that take place during metamorphism. Prerequisite: Min. 483. Lecture 1 to 4 hours, practicum 3 to 6 hours.
Professors P. D. Krynine, E. F. Osborn, T. F. Bates, J. C. Griffiths

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MIN. 460. PHYSICAL MINERALOGY (3) *Professor T. F. Bates*
MIN. 461. DESCRIPTIVE MINERALOGY (3) *Professor T. F. Bates*

* Credits to be arranged, 3-9 per semester.
† Credits to be arranged, 1 per semester.
‡ Credits to be arranged, 1-3 per semester.
§ Credits to be arranged, 2-4 per semester.

MIN. 483. PETROGRAPHY (4) *Professor J. C. Griffiths*
MIN. 485. SEDIMENTATION (3) *Professor P. D. Krynine*
MIN. 486. PETROGRAPHY OF OIL RESERVOIRS (1) *Professor P. D. Krynine*
MIN. 487. PETROGRAPHY OF OIL RESERVOIRS LABORATORY (2) *Professors P. D. Krynine, J. C. Griffiths*

MINING

PROFESSOR ARNOLD W. ASMAN, B.Sc.
Chief of the Division

MNG. 500. MINING SEMINAR (2).—Conferences, reading, and reports. Scientific management; public relations; technological developments. Required of all graduate students in mining engineering. Lecture 2 hours.

MNG. 501. MINE ENGINEERING (3).—Mine mechanization problems. The selection of the most suitable equipment for various conditions. Prerequisite: Mng. 488. Lecture 3 hours.

MNG. 504. MINING RESEARCH (3-10).—Research work on specific problems in physics of mining and mine mechanization. Prerequisites: Mng. 481. Practicum 9 to 30 hours.

MNG. 506. MINE AND MINE PLANT DESIGN (3-10).—The layout, design, and selection of equipment for specific mining and mine plant projects. Prerequisite: Mng. 499. Practicum 9 to 30 hours.

MNG. 520. MINE PLANNING USING CYCLE STUDIES (3-6).—Highly productive cycles of mine section operation are developed by use of time and method studies of the various sub-cycles involved. Prerequisite: Mng. 72.

MNG. 521. MATHEMATICAL ANALYSIS OF MINE LAYOUTS (3).—Proportioning layouts in regard to mineral available, distances, and centroids of mining areas; incremental and sub-cycle costs. Prerequisites: Mng. 488.

MNG. 522. ROCK MECHANICS (3-6).—A detailed study of the physical properties of rocks as affecting the design of underground openings; testing procedures, calculations, and design. Prerequisite: Mng. 499.

MNG. 523. MINE DUSTS (3).—Detailed studies of methods of collecting, sampling, and determining the amount, size, and mineral content of dust in mine atmospheres; methods of dust control. Prerequisite: Mng. 481.

MNG. 524. UNDERGROUND MINING POWER DISTRIBUTION SYSTEMS (3-6).—Calculations involved in the design of power applications and systems for mines; electrical, compressed air; Diesels; package power for extremely gassy conditions; sectionalizing; loads and load centers. Prerequisite: Mng. 488.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MNG. 400. MINE SAFETY ENGINEERING (1) *Mr. A. E. Flowers*
MNG. 481. PHYSICS OF MINING (4)
MNG. 483. MINERAL PROPERTY VALUATION (2) *Mr. A. E. Flowers*
MNG. 488. ADVANCED MINE MECHANIZATION (2)
MNG. 499. ADVANCED MINING DESIGN (2)

MUSIC

PROFESSOR HUMMEL FISHBURN, M.A.
Head of the Department

MUSIC 511-514. ADVANCED PIANO (3 per course.)—Artistic performance of piano literature of all periods; program building stressed according to individual taste and ability; designed to help students prepare for the demands of successful public performance; technique, interpretation, memory, and the qualities that make for musicianship and poise at the piano. Fee $25 per course.
Professor B. S. Brinsmaid

MUSIC 558-561. FREE COMPOSITION (3 per course).—An opportunity for graduate students to do original work under supervision. Weekly conferences; analysis and discussion of the style and technique of standard and contemporary composers; experimental writing in various styles. Prerequisites: harmony 12 credits, piano 8 credits. *Professor G. W. Henninger*

MUSIC 563. FREE ARRANGING (3).—Correct procedure in arranging for vocal and instrumental ensembles; practical exercises in quartets, glee clubs, and choruses; small instrumental groups, band, and orchestra. Prerequisites: harmony 18 credits, including 3 of orchestration. *Professor Hummel Fishburn*

MUSIC 567. THE LITERATURE OF THE ORCHESTRA (3).—Outstanding orchestra works of great composers of that medium, from the appreciation and historic point of view; analysis of the form and styles of the suite, the symphony, the tone poem, and the overture; survey of instrumentation and orchestration from the early chamber group to the present symphony orchestra. Prerequisites: Music 6 and theoretical knowledge of the key instruments of the orchestra. *Professor Hummel Fishburn*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MUSIC 407. PIANO REPERTOIRE (3) *Professor B. S. Brinsmaid*
MUSIC 408. VOCAL LITERATURE (3) *Mrs. Elizabeth Reynolds*
MUSIC 429-432. SINGERS' STYLE AND INTERPRETATION (3 per course).—Fee $25 per course. *Professor Willa Taylor*
MUSIC 456. ELEMENTARY COUNTERPOINT (3) *Professor G. W. Henninger*
MUSIC 464. MUSICAL LITERATURE OF THE ROMANTIC PERIOD (3) *Professor Hummel Fishburn*
MUSIC 465. MUSICAL LITERATURE OF THE MODERN PERIOD (3) *Professor Hummel Fishburn*
MUSIC 466. ADVANCED CONDUCTING (3) *Professor Frank Gullo*

MUSIC EDUCATION

PROFESSOR HUMMEL FISHBURN, M.A.
Head of the Department

MUSIC ED. 500. MUSIC EDUCATION SEMINAR (3-6).—Problems of various phases of music education, both instrumental and vocal; research and literature dealing with these problems. *Professor Hummel Fishburn and Staff*

MUSIC ED. 571. VOCAL PEDAGOGY (3).—Practical ways of solving problems in teaching public school vocal music; physiological, acoustic, and psychological factors

of singing; investigation of traditional methods of training singers; voice class pedagogy and procedures for conducting high school voice training classes. Prerequisites: Music Ed. 48 and teaching experience. *Professor Willa Taylor*

Music Ed. 572. Instrumental Pedagogy (3).—Problems involved in teaching the instruments of the band and orchestra; materials for individual and group instruction; a clinical survey of new materials. Prerequisite: Music Ed. 54, or practical experience. *Professor Hummel Fishburn*

Music Ed. 573. The Materials of Appreciation (3).—Designed to acquaint the teacher of music appreciation with recorded material available for appreciation classes; special emphasis on materials for courses in secondary schools, colleges, and for adult groups, as well as recordings that can be used by instrumental and vocal teachers in their work outside of appreciation classes. Prerequisites: Music 5, and teaching experience. *Professor Frances Andrews*

Music Ed. 574a,b. Present-Day Trends in Music Education (3-6).—Present-day trends in music education in the elementary school with special emphasis upon relationship of music to the entire school program; co-ordination of various types of musical activities; current materials and practices; practical and specific problems of teaching and organization of immediate importance to the personnel of the class. Prerequisites: Music Ed. 48 and teaching experience. *Professor Frances Andrews*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Music Ed. 462. Pedagogy of Theory (3) *Professor G. W. Henninger*
Music Ed. 468. The Teaching of Piano (3) *Professor B. S. Brinsmaid*
Music Ed. 469. Band and Orchestra Technique (3) *Professor Frank Gullo*
Music Ed. 470. Choral Technique (3) *Professor Willa Taylor*
Music Ed. 475. Objectives and Problems in Elementary Music Education (3) *Professor Willa Taylor*

PETROLEUM AND NATURAL GAS

Professor S. T. Yuster, Ph.D.
Chief of the Division

Pet.E. 500a. Petroleum and Natural Gas Engineering Research (3-9 per semester)

Pet.E. 501. Energetics of Petroleum Engineering (3).—Fundamental laws and systematic derivation of formulae with applications to production of petroleum and natural gas; energetics of phase equilibria; use of partial quantities in field problems; deviations from simple mixture laws; applications of material and energy balances. Prerequisite or concurrent: M.E. 104, Pet.E. 481. Lecture 3 hours.

Pet.E. 502a. Petroleum and Natural Gas Engineering Seminar (3-9).—An intensive study of one or several phases of petroleum engineering.

Pet.E. 503. The Flow of Homogeneous Fluids Through Porous Media (3).—The mathematical relations governing the flow of homogeneous liquids through porous media; rate of flow and pressure distribution according to various well spacing

patterns; application to water flooding and gas repressuring. Prerequisites: Math. 431, Pet.E. 74. Lecture 3 hours.

PET.E. 504. WATER FLOODING (3-6).—Fundamental physical forces involved in water flooding, core data interpretation, well spacing, pattern layout, shooting, water treatment, pressure plant, methods of pumping, delayed drilling, selective plugging, use of gas in water flooding, production curtailment, and the economics of water flooding. (Course may be expanded to 6 hours credit with special laboratory problem.) Prerequisite: Chem. 40. Lecture 2 hours, practicum 3 hours.

PET.E. 506. ADVANCED PETROLEUM ENGINEERING (5).—Flow of oil and gas mixtures in vertical pipes; application of the vibration theory to deep well pumping; corrosion of oil field equipment, cathodic protection; production chemistry; mechanical and chemical selective exclusion of liquids from wells; field treatment of crudes, emulsions, field refining of crudes, and salt water disposal. Prerequisites: Chem. 41, Pet.E. 74. Lecture 4 hours, practicum 3 hours.

PET.E. 507. CONDENSATE FIELDS (2).—Retrograde condensation phenomenon of hydrocarbon mixtures at high pressure; literature on condensate fields; production methods and equipment design: casing heads, compressors, separators, stabilizers; safety measures. Prerequisite: Pet.E. 501. Lecture 2 hours.

PET.E. 508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2).—Principals of colloidal activity applied to the control of the properties of clay slips, drilling fluids, and similar suspensions; swelling of shales and bentonites; colloidal phenomena associated with the beneficiation and use of industrial minerals. (In co-operation with the Ceramics staff.) Prerequisite: Chem. 41. Lecture 2 hours.

Professor E. C. Henry

PET.E. 509. ADVANCED PETROLEUM ENGINEERING DESIGN (2).—Continuation of Pet.E. 84. Projects in the selection of engineering materials for casing programs, drilling rigs; production, treatment, stabilization, and transportation of crude oils. Prerequisite: Pet.E. 84. Lecture 1 hour, practicum 3 hours.

PET.E. 510. MODERN METHODS OF HYDROCARBON ANALYSES (3).—Recently developed methods of analysis of hydrocarbon mixtures, principally infrared spectrum analysis, Raman spectrum analysis, magneto-optic analysis, mass spectrum analysis, etc. Lecture 2 hours, practicum 3 hours.

PET.E. LAB. 508. ROTARY DRILLING FLUID LABORATORY (1).—Determination of size distribution of particles, electrodialysis, acid and base exchange capacity, ultimate pH, swelling of clays and its control, viscosity of muds and related properties, thixotropy, weighting materials. Prerequisite: Chem. 41. Concurrent: Pet.E. 508. Practicum 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PET.E. 481. NATURAL GAS AND GASOLINE PLANTS (4)
PET.E. 485. SECONDARY RECOVERY (3)
PET.E. 491. OIL AND GAS RESERVOIR ENGINEERING (3)
PET.E. 492. PETROLEUM ECONOMICS (3)
PET.E. LAB. 481. NATURAL GAS LABORATORY (1)
PET.E. LAB. 490. ADVANCED CORE TESTING (3)

PHILOSOPHY

Professor John M. Anderson, M.A., Ph.D.
Acting Head of the Department

Phil. 500a,b. Ethical Seminar (2-6).—A critical study of some phase of ethical fact and theory.

Phil. 501a,b,c,d. Philosophy Seminar (2-12).—Meets the demand for advanced study in special fields of philosophical thought.

Phil. 502. Theory of Epistemology (3).—A systematic and critical analysis of some aspect of contemporary epistemology. Recitation 3 hours.

Phil. 503. Logic (3).—The logical basis of mathematics and its ultimate nature. Recitation 3 hours.

Phil. 504. Social and Political Philosophy (3).—A critical study of basic problems in their historical and functional setting. Recitation 3 hours.

Phil. 505. Ideals of Western Civilization (3).—An analysis of contemporary ideals in terms of their Graeco-Judean bases. Recitation 3 hours.

Phil. 507. Seminar in History of Philosophy (3-12).—Concentrated study of some work or problem in the history of philosophy. Recitation 3 to 12 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Phil. 402. 17th and 18th Century Philosophy (3)
Phil. 418. Recent and Contemporary Philosophy (3)
Phil. 427. Advanced Ethics (3)
Phil. 428. Advanced Logic (3)
Phil. 430. Honors Course in Philosophy (2)

PHYSICAL EDUCATION

Consult Professor Lloyd M. Jones, M.A., Ph.D.

Phys. Ed. 500. Problem in Physical Education (3).—Prerequisite: Phys. Ed. 455.

Phys. Ed. 510. Program for the Summer Camp (3).—Prerequisites: Phys. Ed. 430 and experience as a camp counselor or director. *Professor F. M. Coombs*

Phys. Ed. 522. Organization and Administration of Physical Education in Colleges and Universities (3).—Procedures and policies involved in the administration of physical education in institutions of higher learning; credits, schedules, excuses, records, reports, budgets, classification, tests, administration of plants and fields, and the relationships of physical education to the educational plan of the institution. Prerequisite: Phys. Ed. 491. *Professor G. N. Thiel*

Phys. Ed. 523. Administration of College Athletics (3).—Eligibility schedules, managerial systems, the relationships of athletics to the physical education program and to education in general; individual or committee reports on topics of special interest. Prerequisite: Phys. Ed. 491. *Professor F. J. Bedenk*

PHYS. ED. 526. ATHLETIC PROBLEMS IN SCHOOLS (3).—Problems of body mechanics in executing the various skills in athletic sports; practical psychology in handling players and assistants; problems of the assignments of responsibility in certain sports; coaching methods; term report on some aspect of high school athletics required. Prerequisites: Phys. Ed. 460, 481. *Professor F. J. Bedenk*

PHYS. ED. 528. PROFESSIONAL EDUCATION OF TEACHERS OF HEALTH AND PHYSICAL EDUCATION (3).—Health and physical education surveys, publicity, sociability and personality tests, legislation, state certification, standards for facilities and equipment, in-service, follow-up, and teacher-community problems; student reports on various aspects of the work. Prerequisite: Phys. Ed. 491. *Professor L. M. Jones*

PHYS. ED. 529. SUPERVISION OF PHYSICAL EDUCATION IN SCHOOLS (3).—Methods and policies of the school supervisor of physical education; detecting and remedying teaching errors, types of conferences, planning and presenting the program, evaluating results, improving teachers-in-service, supervision of the classroom teacher, and relationships with the administration. Prerequisites: Phys. Ed. 491, 452, 453. *Professor L. M. Jones*

PHYS. ED. 530. RESEARCH TECHNIQUES IN HEALTH AND PHYSICAL EDUCATION (3).—Selecting and defining possible problems in health and physical education; scientific methods as applied to this field; sources of data, methods of collecting and interpreting data; methods of writing and publishing reports of problems; periodic student reports demonstrating ability to apply the methods and techniques to a selected problem. Prerequisite: Phys. Ed. 455. *Professor J. D. Lawther*

PHYS. ED. 531. RESEARCH IN HEALTH AND PHYSICAL EDUCATION (3).—Prerequisite: Phys. Ed. 530. *Professor L. M. Jones*

PHYS. ED. 532. TESTS AND MEASUREMENTS IN PHYSICAL EDUCATION (3).—Critical study of the test and measurements available in physical education; methods of constructing and evaluating new tests and measurements. Prerequisite: Phys. Ed. 490. *Professor F. J. Bedenk*

PHYS. ED. 533. RECREATION STUDIES, SURVEYS, AND APPRAISALS (3).—Types, purposes, and methods of conducting recreation studies and surveys; procedures in the appraisal of community recreation. Prerequisite: Phys. Ed. 530. Lecture 3 hours. *Professor F. M. Coombs*

PHYS. ED. 534. STUDIES IN CURRICULUM CONSTRUCTION IN PHYSICAL EDUCATION (3).—An overview of principles and methods of curriculum and course of study building in physical education; the different psychological and educational points of view as related to curriculum construction, organizing a course of study committee, setting up objectives and guiding principles, making units of construction. Prerequisites: Phys. Ed. 452, 453, 454. *Professor L. M. Jones*

PHYS. ED. 535. MODERN FOREIGN SYSTEMS OF PHYSICAL EDUCATION (3).—Comparative analysis of national and local programs and systems of physical education in foreign countries. Prerequisites: Phys. Ed. 534, 595. *Professor C. M. Speidel*

PHYS. ED. 536. SCIENTIFIC METHODS IN ATHLETIC COACHING (3).—Unusual techniques in athletic coaching which are not commonly recognized and used; advanced skills and strategy in coaching major sports. Prerequisite: Phys. Ed. 460. *Professor J. D. Lawther*

PHYS. ED. 550. SEMINAR IN HEALTH AND PHYSICAL EDUCATION (1-6).—Open only to students preparing approved theses and dissertations.
Professor L. M. Jones and Staff

PHYS. ED. 555. RELATIONSHIPS OF PHYSICAL EDUCATION TO THE EXACT SCIENCES (3).—Anatomy, physiology, chemistry, physics, biology, studied for the purpose of collecting and classifying scientific facts which form the foundations of certain policies, procedures, principles, programs, objectives, and standards of physical education. Prerequisite: Phys. Ed. 481. *Professor Mildred Lucey*

PHYS. ED. 560. ADMINISTRATIVE PROBLEMS OF PHYSICAL EDUCATION IN SCHOOLS (3).—Solutions to problems emerging from the administration of physical education in schools, such as credit for college entrance, relationships of physical education to health education, fitting physical education into the school's schedule, the handling of excuses and absences, measuring and evaluating results, awards and budgets. Prerequisite: Phys. Ed. 491. *Professor L. M. Jones*

PHYS. ED. 595. PHILOSOPHY OF HEALTH AND PHYSICAL EDUCATION (3).—The philosophical factors underlying past and future considerations of health and physical education; particular attention to the various crucial forces influential in changing one's philosophy of health and physical education. Prerequisites: Phys. Ed. 454, 491. *Professor L. M. Jones*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PHYS. ED. 424. MODERN TRENDS IN HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS (3) *Professor L. M. Jones*
PHYS. ED. 429S. THE MODERN DANCE IN EDUCATION (3)
Professor Dorothy Briant
PHYS. ED. 430. INTRODUCTION TO ORGANIZED CAMPING (3)
Professor F. M. Coombs
Unit A. Scope, Significance, and Leadership (1)
Unit B. Facilities, Equipment, and Organization of Activities (1)
Unit C. Administrative Procedures (1)
PHYS. ED. 431S. COACHING OF ADVANCED BASEBALL (3)
Professor F. J. Bedenk
PHYS. ED. 432. RECREATION IN INDUSTRY (3) *Professor F. M. Coombs*
PHYS. ED. 433. ANALYSIS OF RECREATIONAL METHODS (3)
Professor F. M. Coombs
PHYS. ED. 435. ORGANIZATION AND ADMINISTRATION OF OUTDOOR RECREATION (1 per unit) *Professor F. M. Coombs*
Unit A. Administrative Procedures and Policies (1)
Unit B. Conduct of the Program (1)
Unit C. Facilities, Equipment, and Finances (1)
PHYS. ED. 436S. COACHING OF ADVANCED FOOTBALL (3)
Professor R. A. Higgins
PHYS. ED. 437S. COACHING OF ADVANCED BASKETBALL (3)
Professor J. D. Lawther
PHYS. ED. 438S. COACHING OF ADVANCED TRACK (3)
Professor C. D. Werner
PHYS. ED. 439S. COACHING OF ADVANCED SOCCER (3) *Mr. W. Jeffrey*
PHYS. ED. 440S. COACHING OF ADVANCED GYMNASTICS (3)
Professor E. Wettstone

PHYS. ED. 441S. ADVANCED COACHING OF ATHLETICS FOR MEN (1-11)

Unit A. Basketball (1) — *Professor J. D. Lawther*
Unit B. Football (1) — *Professor R. A. Higgins*
Unit C. Track and Field (1) — *Professor C. D. Werner*
Unit D. Baseball (1) — *Professor F. J. Bedenk*
Unit E. Wrestling (1) — *Professor C. M. Speidel*
Unit F. Soccer (1) — *Mr. W. Jeffrey*
Unit G. Swimming (1)
Unit H. Gymnastics (1) — *Professor E. Wettstone*
Unit I. Boxing (1)
Unit J. Lacrosse (1)
Unit K. Fencing (1)

PHYS. ED. 449S. ADVANCED TEACHING OF SPORTS AND RHYTHMICS (1-8)

Unit A. Soccer and Speedball (1) — *Professor Mildred Lucey*
Unit B. Basketball (1) — *Professor Mildred Lucey*
Unit C. Field Hockey (1) — *Professor Mildred Lucey*
Unit D. Archery (1) — *Professor Marie Haidt*
Unit E. Swimming (1)
Unit F. Rhythmics for Children (1) — *Professor Dorothy Briant*
Unit G. Modern Dance and Accompaniment (1) — *Professor Dorothy Briant*
Unit H. Early American Country Dancing and Social Dancing (1) — *Professor Dorothy Briant*
Unit I. Tennis (1)
Unit J. Badminton (1)
Unit K. Golf (1)

PHYS. ED. 452S, 452X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE ELEMENTARY SCHOOL (3) — *Professor C. M. Speidel*

PHYS. ED. 453S, 453X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE HIGH SCHOOL (3) — *Professor E. C. Bischoff*

PHYS. ED. 454. THE NATURAL PROGRAM OF PHYSICAL EDUCATION ACTIVITIES, APPLIED (3) — *Professor E. C. Bischoff*

PHYS. ED. 455. SCIENTIFIC METHOD IN HEALTH AND PHYSICAL EDUCATION (3) — *Professor L. M. Jones*

PHYS. ED. 456. THE CO-RECREATIONAL PROGRAM IN SCHOOLS (2) — *Professor F. M. Coombs*

PHYS. ED. 460. METHODS AND PRINCIPLES OF ATHLETIC COACHING (3) — *Professor J. D. Lawther*

PHYS. ED. 461, 461X. PROGRAMS OF COMMUNITY RECREATION (1 per unit) — *Professor F. M. Coombs*

Unit A. Programs of the Rural Community (1)
Unit B. Programs of the Urban Community (1)
Unit C. Programs of the Large Municipalities (1)

PHYS. ED. 462. RECREATION FOR THE HANDICAPPED (3) — *Professor C. M. Speidel*

PHYS. ED. 463. RECREATION LAW (3) — *Professor F. M. Coombs*

PHYS. ED. 465. ADMINISTRATION OF RECREATION (3) — *Professor F. M. Coombs*

PHYS. ED. 466S. VISUAL INSTRUCTION IN ATHLETICS (3) — *Professor R. M. Conger*

PHYS. ED. 471S. HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS FOR THE SCHOOL ADMINISTRATOR (3)
Professor L. M. Jones

Unit A. Athletics in the Schools (1)
Unit B. Health Education in the Schools (1)
Unit C. Physical Education and Recreation in the Schools (1)

PHYS. ED. 480. ADVANCED ANATOMY AND PHYSIOLOGY, APPLIED (3)
Professor Ellen Kelly

PHYS. ED. 481, 481X. PROBLEMS IN BODY MECHANICS (3)
Professor Ellen Kelly

PHYS. ED. 482, 482X. POSTURE EDUCATION IN THE SCHOOLS (3)
Professor Ellen Kelly

PHYS. ED. 488S. THE ADMINISTRATION OF PHYSICAL EDUCATION AND ATHLETICS FOR WOMEN (3) *Professor Marie Haidt*

PHYS. ED. 489. INTRAMURAL ATHLETICS (3) *Professor E. C. Bischoff*

PHYS. ED. 490. INTRODUCTORY COURSE IN TESTS AND MEASUREMENTS IN HEALTH AND PHYSICAL EDUCATION (3)
Professor F. J. Bedenk

PHYS. ED. 491. ORGANIZATION AND ADMINISTRATION OF HEALTH AND PHYSICAL EDUCATION IN SCHOOLS (3) *Professor L. M. Jones*

PHYSICS

PROFESSOR HAROLD K. SCHILLING, M.A., Ph.D.
Head of the Department

PHYS. 501a,b,c,d,e. PHYSICS RESEARCH (1-15 per semester).—Original work to obtain material for a thesis. May be continued in successive semesters as Phys. 501b, 501c, etc. to a maximum of 45 credits.

PHYS. 507. THEORETICAL THERMODYNAMICS (3).—A mathematical treatment of the principles of thermodynamics. Lecture 3 hours.

PHYS. 509. PHYSICS SEMINAR (1).—Selected topics from current physical research critically examined and discussed. May be continued in successive semesters as Phys. 509a, 509b, 509c. Seminar.

PHYS. 517. KINETIC THEORY (3).—The Maxwell-Boltzmann law, Brownian movements, specific heats, and other selected topics. Prerequisites: Phys. 411, Math. 431. Lecture 3 hours.

PHYS. 521. CRYSTAL STRUCTURE (3).—The solution of the structure of crystals by X-ray methods. Lecture 3 hours. Available for major credit in either physics or chemistry.

PHYS. 522. ADVANCED CRYSTAL ANALYSIS (3).—Continuation of Phys. 521, including the application of crystal structure studies to physical, chemical, and metallurgical problems. Available for major credit in either physics or chemistry. Lecture 3 hours.

PHYS. 530. INTRODUCTION TO THEORETICAL PHYSICS (3).—The application of higher mathematics to problems in the various fields of physics. Prerequisites: Math. 431, Phys. 285. Lecture 3 hours.

PHYS. 531. THEORETICAL PHYSICS (3).—Continuation of Phys. 530.

PHYS. 533. THEORY OF SOUND (3).—Mathematical treatment of the theory of sound. Prerequisite: Phys. 530. Lecture 3 hours.

PHYS. 551. ADVANCED ELECTRON THEORY (1-3).—Properties of matter in terms of modern electron theory. Prerequisite: Phys. 531. Lecture 1 to 3 hours.

PHYS. 553. NUCLEAR PHYSICS (3).—Mathematical course in nuclear physics. Prerequisite: Phys. 562. Lecture 3 hours.

PHYS. 557. ELECTRICITY AND MAGNETISM (3).—A treatment of the mathematical theory of electricity and magnetism. Prerequisite: Phys. 467. Lecture 3 hours.

PHYS. 558. ELECTRICITY AND MAGNETISM (3).—Continuation of Phys. 557. Prerequisite: Phys. 557. Lecture 3 hours.

PHYS. 559. PHYSICAL OPTICS (3).—Advanced study of the physical properties of light. Prerequisite: Phys. 459. Lecture 3 hours.

PHYS. 560. ADVANCED PHYSICAL MEASUREMENTS (1-18).—Offers opportunity for advanced work in the various fields of physics.

PHYS. 561. DE BROGLIE WAVES AND QUANTUM MECHANICS (3).—An introduction to the modern interpretation of atomic structure and radiation phenomena, based upon the de Broglie and Schroedinger wave theory. Prerequisite: Phys. 531. Lecture 3 hours.

PHYS. 562. WAVE MECHANICS IN MODERN PHYSICS (3).—This continuation of Phys. 561 discusses the theory of atomic and simple molecular spectra, Zeeman and Stark effect, theories of metallic conductivity and thermionic emission, etc. Prerequisite: Phys. 561. Lecture 3 hours.

PHYS. 571. ATOMIC STRUCTURE (3).—Recent work in atomic and subatomic physics. Lecture 3 hours.

PHYS. 572. SPECTROSCOPY (3).—Atomic and molecular spectra, both emission and absorption methods of excitation, radiation and ionization potentials, spectral series, fine structure, spectra of ionized and stripped atoms. Lecture 3 hours.

PHYS. 575. PROBLEMS IN MODERN PHYSICS (1-3).—Theoretical studies in any field of modern physics with or without associated experimental work. Prerequisite: Phys. 455.

PHYS. 577. CLASSICAL MECHANICS (3).—The principles and applications of classical mechanics. Prerequisite: Phys. 461. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PHYS. 401. ELECTRONICS (3)
PHYS. 403. VACUUM TUBE CIRCUITS (3)
PHYS. 404. MEASUREMENTS EMPLOYING VACUUM TUBES (2-4)
PHYS. 411. THEORETICAL MECHANICS (3)
PHYS. 433S. INTERMEDIATE MECHANICS AND FLUID PHYSICS (3)
PHYS. 435S. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
PHYS. 437S. INTERMEDIATE HEAT, SOUND, AND LIGHT (3)
PHYS. 439S. ELEMENTARY SURVEY OF MODERN PHYSICS (3)
PHYS. 443. INTERMEDIATE ACOUSTICS (3)
PHYS. 444. MEASUREMENTS IN ACOUSTICS (2)
PHYS. 451. ELECTRONICS AND IONICS (3)

PHYS. 452. ELECTRONIC MEASUREMENTS (2-4)
PHYS. 453. ELECTRON OPTICS AND POSITIVE ION BEAMS (3)
PHYS. 455. SURVEY OF MODERN PHYSICS (3)
PHYS. 459. INTERMEDIATE OPTICS (3)
PHYS. 460. INTERMEDIATE LABORATORY OPTICS (2-4)
PHYS. 461. THEORETICAL MECHANICS (3)
PHYS. 463. RADIOACTIVITY AND NUCLEAR PHYSICS (3)
PHYS. 467. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
PHYS. 468. ADVANCED ELECTRICAL MEASUREMENTS (2)
PHYS. 480. GLASS WORKING AND LABORATORY TECHNIQUES (1-3)
PHYS. 486. ASTRONOMICAL PHOTOGRAPHY (3-6)
PHYS. 490. MODERN STELLAR THEORY (3-9)
PHYS. 491S. ADVANCED CELESTIAL MEASUREMENTS (3-9)

POLITICAL SCIENCE

PROFESSOR M. NELSON MCGEARY, M.A., Ph.D.
Head of the Department

POL. SCI. 500. SEMINAR IN POLITICAL SCIENCE (3-12).—Subject to be announced.

POL. SCI. 505. SEMINAR IN ADVANCED AMERICAN GOVERNMENT (3-12)

POL. SCI. 510. POLITICAL AND ADMINISTRATIVE PROBLEMS IN PENNSYLVANIA (3-6).—Lecture 3 hours.

POL. SCI. 512. COMPARATIVE GOVERNMENT (3-12)

POL. SCI. 515. INTERNATIONAL RELATIONS (3-6).—Current international relations and problems as they appear in the application of the Monroe Doctrine, the work of international organizations, and the programs of nationalism and internationalism. Lecture 3 hours.

POL. SCI. 516. INTERNATIONAL LAW (3-6)

POL. SCI. 517. INTERNATIONAL ORGANIZATION (3-6)

POL. SCI. 519. PUBLIC ADMINISTRATION (3-6)

POL. SCI. 520. ADMINISTRATIVE LAW (3-6).—The law dealing with public officers and their procedure; the scope and limits of administrative powers; remedies against illegal government acts. Lecture 3 to 6 hours.

POL. SCI. 521. POLITICAL THEORY (3-6)

POL. SCI. 525. POLITICAL PARTIES (3-6)

POL. SCI. 526. PUBLIC OPINION AND PROPAGANDA (3-6)

POL. SCI. 533. LABOR AND WELFARE LEGISLATION (3-6)

POL. SCI. 535. GOVERNMENT REGULATION (3-6)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

POL. SCI. 413. GOVERNMENT AND FOREIGN POLICY OF THE SOVIET UNION (3)
POL. SCI. 415. INTERNATIONAL ORGANIZATION (3)

Pol. Sci. 416. International Law (3)
Pol. Sci. 417. Municipal Government (3)
Pol. Sci. 419. Public Administration (3)
Pol. Sci. 420. Public Personnel (3)
Pol. Sci. 421. Modern Political Theories (3)
Pol. Sci. 424. State Government in the United States (3)
Pol. Sci. 427. Public Opinion and Propaganda (3)
Pol. Sci. 428. Pennsylvania Local Government (3)
Pol. Sci. 429. Pennsylvania Local Administration (3)
Pol. Sci. 431. Ancient and Medieval Political Theories (3)
Pol. Sci. 432. Current Political Trends and Problems in the United States (3-9)
Pol. Sci. 433. Labor and Welfare Legislation and Administrative Problems (3)
Pol. Sci. 435. Government Housing, Planning, and Public Works (3)
Pol. Sci. 442. American Foreign Policy (3)
Pol. Sci. 444. Government Regulation (3)
Pol. Sci. 445. Administrative Law (3)
Pol. Sci. 446. Judicial Systems (3)
Pol. Sci. 450. Government and Foreign Policies of Britain and the Commonwealth (3)
Pol. Sci. 452. Governments and Foreign Policies of Western Europe (3)
Pol. Sci. 454. Governments and Foreign Policies of Eastern Europe (3)
Pol. Sci. 456. Governments and Foreign Policies of Latin America (3)
Pol. Sci. 458. Governments and Foreign Policies of the Far East (3)

POULTRY HUSBANDRY

Professor Ernest W. Callenbach, M.S.
Head of the Department

P.H. 502. Advanced Poultry Nutrition (2-4).—Prerequisite: P.H. 3. *Professor R. R. Murphy*

P.H. 503. Advanced Poultry Farm Management (2-4).—Prerequisite: P.H. 8. *Professor E. W. Callenbach*

P.H. 504. Advanced Poultry Marketing (2-4).—Prerequisites: P.H. 1, 7; Agr. Ec. 2 or 2 additional credits in poultry husbandry. *Professor P. H. Margolf*

P.H. 505. Research in Poultry Husbandry (3-10).—Prerequisite: 9 credits in poultry husbandry. *Professor E. W. Callenbach*

P.H. 506. Seminar in Poultry Husbandry (1-6) *Professor E. W. Callenbach and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

P.H. 412. Poultry Breeding (3) *Professor A. J. G. Maw*

PSYCHOLOGY

Professor B. V. Moore, M.A., Ph.D.
Head of the Department

Psy. 500. Seminar: Introduction to Research Methods (1).—Prerequisite: 12 credits in psychology. Lecture 1 hour.

Psy. 501. Advanced Psychology (2-4).—A comprehensive study of general psychology. Prerequisite: 9 credits in psychology.

Psy. 502. Advanced Educational Psychology (2-4).—Psychological theories and principles underlying educational theories and practices. Prerequisites: Psy. 14 or 414; Ed. 31 or teaching experience. *Professor E. B. van Ormer*

Psy. 503. Physiological Psychology (2-4).—Correlations between the structure and function of the nervous system and the phenomena of human consciousness; important laws and theories in the fields of sensation, attention, association, and affection. Prerequisite: 9 credits in psychology. *Professor J. E. DeCamp*

Psy. 504. Comparative Psychology (2-4).—Mind from the standpoint of growth and development; biological implications; a comparison of simple and complex animal forms with that of man; growth of the human mind paralleling physical growth. Prerequisite: 9 credits in psychology. *Professor J. E. DeCamp*

Psy. 505. Research Problems in Psychology (1-15).—Prerequisite: 12 credits in psychology.

Psy. 506. Clinical Psychology (1-6).—Procedures used in the Psychology Clinic. Limited to students enrolled in Psy. 507. Prerequisites: Ed. 70 or Psy. 471; Psy. 550 or 551. *Professor W. U. Snyder*

Psy. 508. Procedures in Guidance and Personnel Administration (2-6).—Analysis of the more technical problems of guidance counseling and personnel administration, and a critical evaluation of various techniques and devices available for meeting these problems. These methods and procedures will be organized into programs for specific purposes in particular situations. Prerequisites: Ed. 453, Psy. 14. *Professor B. V. Moore*

Psy. 510. History of Psychology (2-4).—The great systems, experiments, and personalities in the development of modern psychology, particularly since Fechner's time. Prerequisite: 9 credits in psychology.

Psy. 511. Contemporary American Psychology (2).—Current systems or schools of psychology with a comparative study and critical analysis of each. Each point of view as presented by the recognized leaders will be studied. Each student will be expected to organize his own way of thinking in psychology and defend his point of view. Prerequisite: Psy. 510. *Professor B. V. Moore*

Psy. 513. Educational Psychology: Differential (2).—The nature of individual differences in abilities, achievement, attitudes, interests, and various other emotional and social traits of personality; causes of these differences; and psychological implications of the methods used by schools in adjusting to individual differences. Prerequisites: Psy. 14 or 414 and 6 credits at 400 level in psychology. Lecture 2 hours. *Professor E. B. van Ormer*

Psy. 514. Educational Psychology: Learning (2).—Experimentally determined facts about the learning process; main theories of learning suggested in explanation of the facts; educational implications of each theory; attempted synthesis and application of learning principles; and the special principles derived from studies

of memory and retention, transfer of training, and motivation. Prerequisites: Psy. 14 or 414 and 6 credits at 400 level in psychology. Lecture 2 hours.
Professor E. B. van Ormer

Psy. 515. Advanced Statistics in Psychology and Education (3).—Sampling, tests of significance, factor analysis, analysis of variance, and other advanced statistical methods; the application of statistical methods to practical problems. Prerequisite: Psy. 415 or Ed. 574. Recitation 3 hours.

Psy. 521. Research Problems in Industrial Psychology (2-6).—Work on actual industrial personnel problems in laboratory and industrial plants; treatment of problems in monotony, fatigue, psychological selection, and training procedures, etc., in industry as opportunity affords and as indicated by interests of the student. Prerequisites: Psy. 21 or 421, and 431. *Professor K. R. Smith*

Psy. 522. Advanced Psychological Marketing Research Techniques (3-6).—Readings, practicum, and class discussion of technical aspects of sampling; construction, tabulation, and interpretation of questionnaires designed to test consumer reaction to products, advertising, and company policies from a psychological standpoint; special attention to analysis of motivation in consumer behavior. Prerequisites: 15 credits in psychology, including Psy. 15, 21, 422. Lecture 2 to 4 hours, practicum 1 to 2 hours. *Professor L. P. Guest*

Psy. 540. Clinical Psychology Seminar (1-6).—Seminar on current problems in clinical psychology. Prerequisite: Psy. 482.

Psy. 541. Dynamics of Human Adjustment (3).—Seminar on motivation of human behavior, frustration, and mechanisms of adjustment; normal behavior is stressed. Prerequisite: Psy. 437.

Psy. 542. Psychopathology (3).—Seminar on causes, clinical types and treatment of mental deficiency, psychoneuroses, and psychoses; symptoms and syndromes. Prerequisite: Psy. 412.

Psy. 543. Counseling Techniques (2).—Seminar on theory and methodology of various standard techniques of counseling and psychotherapy, with stress on the applicability of each. Prerequisite: Psy. 482. *Professor W. U. Snyder*

Psy. 550. Psychometrics: Binet (2).—The measurement of intelligence by means of the Stanford revision of the Binet-Simon technique; demonstrations, lectures; practice in the administration of the tests; observations of the individual student by the instructor. Prerequisite: Psy. 471.

Psy. 551. Psychometrics: Point Scales (2).—Measurement of intelligence by means of individual nonverbal techniques; the Arthur point scale of performance tests and the Cornell-Coxe point performance scale; demonstration, lectures, and practice in the administration of tests; observation of the individual student by the instructor. Prerequisite: Psy. 471.

Psy. 552. Psychometrics: Preschool (2).—Measurement of intelligence by means of individual preschool scales; stressing the Merrill-Palmer, the Minnesota, the California First Year, and the Gesell scales; demonstrations, lectures, and practice in the administration of tests; observation of the individual student by the instructor. Prerequisite: Psy. 551. Lecture 1 hour, practicum 2 hours.

Psy. 553. Psychometrics: Advanced (2).—Measurement of intelligence, social maturity, and other characteristics; demonstration, lectures, and practice in the administration of the tests; observation of the individual student by the instructor. Prerequisite: Psy. 550.

PSY. 554. PSYCHOMETRICS: SENSORY (2-3).—The measurement of auditory and visual acuity and defects; psychophysiological theory; demonstrations, lectures, and practice in the administration and interpretation of tests; observation of the individual student by the instructor. Prerequisite: Psy. 4. Lecture 1 or 2 hours, practicum 2 hours.

PSY. 555. PSYCHOMETRICS: PROJECTIVE (3).—Principles and methods of using and evaluating projective techniques, with particular attention to Rorschach. Prerequisite: Psy. 550. Lecture 2 hours, practicum 2 hours.

PSY. 556. PSYCHOMETRICS: ADVANCED PROJECTIVE (3).—Continuation of Psy. 555, with attention to other projective techniques, such as the Thematic Apperception, play, and dramatics; further consideration of the Rorschach. Prerequisite: Psy. 555. Lecture 2 hours, practicum 2 hours.

PSY. 560. CLINICAL PRACTICUM: GENERAL (1-12).—Practical experience in the Psychology Clinic on all available types of cases; diagnosis and therapy; staff meetings; seminar on techniques. Prerequisites: Psy. 482, 550, 551.

PSY. 561. CLINICAL PRACTICUM: ELEMENTARY SCHOOL (1-3).—Practical experience in the Psychology Clinic and in the public schools on elementary school cases of learning and adjustment problems; diagnosis and remedial work; staff meetings; seminar on pertinent school laws and regulations. Prerequisites: Psy. 560 and Ed. 70, or Ed. 432g or 470.

PSY. 562. CLINICAL PRACTICUM: VOCATIONAL GUIDANCE (1-3).—Practical experience in the Psychology Clinic on high school, college, and adult vocational guidance cases; staff meetings; seminar on techniques and materials. Prerequisites: Psy. 560 or Ed. 453, Ed. 474 and Psy. 472.

PSY. 563. CLINICAL PRACTICUM: MARITAL COUNSELING (1-3).—Practical experience in the Psychology Clinic on premarital and marital adjustment problems; staff meetings; seminar on principles and techniques of adjustment and the development of sexual and emotional maturity in marriage. Prerequisite: Psy. 560.

Professor C. R. Adams

PSY. 564. CLINICAL PRACTICUM: PERSONAL PROBLEMS (2).—Practical experience in the Psychology Clinic in the use of advanced techniques of counseling and psychotherapy for personal problems; staff meetings; seminar on principles and techniques. Prerequisite: Psy. 565.

PSY. 565. CLINICAL PRACTICUM: NONDIRECTIVE (1-3).—Practical experience in the Psychology Clinic in the use of nondirective therapy; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560. *Professor W. U. Snyder*

PSY. 566. CLINICAL PRACTICUM: HYPNOTHERAPY (1-3).—Practical experience in the Psychology Clinic in the use of hypnotherapy; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

PSY. 567. CLINICAL PRACTICUM: PLAY THERAPY (1-3.)—Practical experience in the Psychology Clinic in the use of play therapy with young children; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

PSY. 568. CLINICAL PRACTICUM: GROUP THERAPY (2).—Practical experience in the Psychology Clinic in the use of group methods for the treatment of personal maladjustments; staff meetings; seminar on principles and techniques. Prerequisite: Psy. 565.

PSY. 590. SEMINAR: ADVANCED (1-4).—Prerequisite: Psy. 500.

PSY. 599. THESIS (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PSY. 400. HONORS COURSE IN PSYCHOLOGY (2-6)
PSY. 407. INTERMEDIATE EXPERIMENTAL PSYCHOLOGY (3) *Professor W. M. Lepley*
PSY. 409. BIO-PSYCHOLOGY (3) *Professor C. R. Carpenter*
PSY. 411, 411X. PSYCHOLOGY OF THE PRESCHOOL CHILD (3) *Professor E. B. van Ormer*
PSY. 412, 412X. ABNORMAL PSYCHOLOGY (3) *Professor J. E. DeCamp*
PSY. 414, 414X. INTERMEDIATE EDUCATIONAL PSYCHOLOGY (2-3) *Professor E. B. van Ormer*
PSY. 415, 415X. INTERMEDIATE STATISTICS IN PSYCHOLOGY AND EDUCATION (1-3)
PSY. 417. SOCIAL PSYCHOLOGY (2-3) *Professor C. R. Carpenter*
PSY. 418. MEASUREMENT OF PERSONALITY (2-3)
PSY. 419. GUIDANCE AND EDUCATION IN SEXUAL AND MARITAL ADJUSTMENT (3) *Professor C. R. Adams*
PSY. 420. APPLIED SOCIAL PSYCHOLOGY (3)
PSY. 421. ADVANCED APPLIED PSYCHOLOGY (3)
PSY. 422. PSYCHOLOGICAL METHODS OF MEASURING THE REACTIONS OF THE PUBLIC (3) *Professor L. P. Guest*
PSY. 423. TEST CONSTRUCTION AND STANDARDIZATION (2-3) *Professor C. R. Adams*
PSY. 424. PSYCHOLOGICAL TECHNIQUES IN PUBLIC PERSONNEL ADMINISTRATION (3) *Professor C. R. Adams*
PSY. 425, 425X. PSYCHOLOGY OF THE ELEMENTARY SCHOOL CHILD (2-3) *Professor E. B. van Ormer*
PSY. 426, 426X. ADOLESCENCE (2-3) *Professor E. B. van Ormer*
PSY. 427. PSYCHOLOGICAL PRINCIPLES IN ADVERTISING (3) *Professor L. P. Guest*
PSY. 431. INDUSTRIAL PSYCHOLOGY (3) *Professor K. R. Smith*
PSY. 437, 437X. MENTAL HYGIENE (2-4)
PSY. 440. PSYCHOLOGY PROJECTS (1-6)
PSY. 471, 471X. MEASUREMENT OF INTELLIGENCE (2) *Professor W. U. Snyder*
PSY. 472. SPECIAL ABILITY TESTING (2)
PSY. 482. INTRODUCTION TO CLINICAL PSYCHOLOGY (3)

PUBLIC UTILITIES

PROFESSOR ERIC A. WALKER, M.S., Sc.D.
Head of the Department of Electrical Engineering

PUB. UTIL. 521. PUBLIC UTILITIES (3).—Problems of current interest in the public utility field, principally those utilities involving the use of the principles of electrical engineering. One or two conferences per week. *Professor L. A. Doggett*

In addition to this course the following may be taken for graduate credit under the restrictions in force:

PUB. UTIL. 421. ELECTRIC UTILITIES (3) *Professor L. A. Doggett*

*RURAL SOCIOLOGY

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.
Head of the Department of Agricultural Economics and Rural Sociology

RUR. SOC. 551. RURAL SOCIOLOGY SEMINAR (1-6).—Prerequisite: 6 credits in rural sociology, sociology, or psychology. Lecture 3 hours.

RUR. SOC. 552. THE STRUCTURE OF RURAL SOCIETY (3).—Systematic review of research dealing with the structure of rural society; the purpose, methodology, and contribution of each study treated. Prerequisites: Rur. Soc. 11, Soc. 1. Recitation 3 hours.

RUR. SOC. 553. RURAL SOCIAL PROCESSES (3).—Continuation of Rur. Soc. 552. The functioning of rural society; research dealing with the subject reviewed and evaluated. Prerequisites: Rur. Soc. 11, 552. Recitation 3 hours.

RUR. SOC. 554. ADVANCED RURAL SOCIAL WELFARE (3).—Analysis of welfare techniques and their application to rural situations. Prerequisites: Rur. Soc. 11; Psy. 2 or Rur. Soc. 459. Recitation 3 hours. *Professor W. G. Mather*

RUR. SOC. 555. THE RURAL CHURCH (3).—The rural church as a social institution; its relation to the community; the church in "problem" areas; effects of population trends on the program of the rural church; the use of case studies and surveys. Prerequisite: 6 credits in rural sociology, sociology, or psychology. Recitation 3 hours.
Professor W. G. Mather

RUR. SOC. 556. THESIS IN RURAL SOCIOLOGY (6).—A preparation of the required thesis for the degree of Master of Science in rural sociology while in residence at the College.

RUR. SOC. 557. THE DEVELOPMENT OF THE RURAL COMMUNITY (3).—The origin and evolution of the rural community under different geographic and cultural conditions. Prerequisites: Rur. Soc. 11 or Soc. 1; Rur. Soc. 452 or Soc. 415a. Recitation 3 hours. *Professor W. G. Mather*

RUR. SOC. 559. ADVANCED RURAL SOCIAL PSYCHOLOGY (3).—The application of social psychological principles to the treatment of rural problems. Prerequisites: Rur. Soc. 11, Psy. 2. Recitation 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

RUR. SOC.	452.	RURAL ORGANIZATION (3)	
RUR. SOC.	454.	RURAL SOCIAL WELFARE (3)	*Professor W. G. Mather*
RUR. SOC.	456.	RURAL STANDARDS OF LIVING (3)	*Professor W. G. Mather*
RUR. SOC.	459.	RURAL SOCIAL PSYCHOLOGY (3)	

SOCIOLOGY

PROFESSOR SETH W. RUSSELL, M.A., Ph.D.
Acting Head of the Department

SOC. 502. AMERICAN SOCIOLOGY (3).—Special problems in sociological theory in the United States. Prerequisite: Soc. 402. Recitation 3 hours.
Professor L. L. Bernard

* Credit in rural sociology will also be given for Agr. Ec. 505 and 525.

Soc. 503. Problems of Social Psychology (3).—Investigation of the theories, methods, and empirical data of social psychology, with particular reference to such problems as the relations between personality and culture, social and personal disorganization, the development of role behavior, and the conception of the self.
Professor W. Coutu

Soc. 510. Field Work in Sociology (1-3).—Advanced research projects to be carried out in the field under the supervision of the department and recognized social agencies.

Soc. 512. Modern Criminology (3). *Professor R. E. Clark*

Soc. 513. Advanced Sociological Research Methods and Techniques (3).—Special problems in scientific method and research technique; designed to prepare the student for social inquiry on a professional level; embraces both quantitative and nonquantitative type of work. Prerequisites: Soc. 413 and 3 credits of statistics. *Professor M. E. John*

Soc. 515. Structure and Functions of the Community (3)
Professor Jessie Bernard

Soc. 516. Sociological Theory (3) *Professor L. L. Bernard*

Soc. 519. Seminar in Race Relations (3-6).—The status and problems of minority peoples in selected areas of the world; analysis of the material, social, and sociopsychic aspects of race relations presented in lectures, reports, and papers. Lecture 3 hours.

Soc. 523. Advanced Research in Population (3).—Supervised original research on some aspect of demographic phenomena and vital statistics; a genuine contribution to knowledge is expected of the student. *Professor O. D. Duncan*

Soc. 525. Seminar in Sociology (1-9).—An advanced seminar in sociological theory, involving intensive study of the works of several eminent authors. The list of social theorists dealt with varies from one semester to another, but only those are selected who have made fundamental contributions to the analysis of social structure, social interaction, and social change.

Soc. 530. Research on Marriage and the Family (3).—Training in methods and techniques of research in family relations. Under the guidance of the instructor, experimental, statistical, and comparative studies are carried out, individually or co-operatively. Prerequisites: graduate standing and 3 hours' previous work in this field. Lecture 3 hours. *Professor Jessie Bernard*

Soc. 534. Problems in Social Control (3).—An advanced seminar dealing with the cohesive factors in societies and groups. Differentiates the forms and the instrumentalities of social control, traces their development in different periods, and attempts a systematic explanation of them, utilizing experimental and quantitative approaches where applicable. *Professor L. L. Bernard*

Soc. 540. Anthropological Theory (3).—A seminar in which major anthropological concepts and theories are critically studied. Anthropological theories are tested by the use of empirical ethnological material.

Soc. 570. Advanced Sociological Statistics (3).—Application of advanced statistical technique to sociological research. Prerequisite: Soc. 470. Lecture 3 hours, practicum 2 hours. *Professor R. E. Clark*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Soc. 400. Sociological Theory (3) *Professors L. L. Bernard, S. W. Blizzard Jr.*
Soc. 401. Social Institutions (3) *Professor S. W. Russell*
Soc. 402. American Sociology (3) *Professor L. L. Bernard*
Soc. 403a. Personality and Social Adjustment (3) *Professor W. Coutu*
Soc. 403b. Personality and Social Adjustment (3) *Professor W. Coutu*
Soc. 405S. Social Problems (3)
Soc. 408. Social Ecology (3) *Professor S. W. Blizzard Jr.*
Soc. 413. Methods and Techniques of Social Research (1-6) *Professor Jessie Bernard*
Soc. 415a. Community Institutions (3) *Professor Jessie Bernard*
Soc. 418. The Development of Social Thought (3)
Soc. 419. Minority Peoples (3)
Soc. 423. Population Research (3) *Professor O. D. Duncan*
Soc. 424. Social Change (3)
Soc. 425. Contemporary Sociological Theory (3) *Professor L. L. Bernard*
Soc. 426. Introduction to Public Welfare (3) *Professor W. G. Mather*
Soc. 427S. Family Case Work (6)
Soc. 440. Primitive Society (3)
Soc. 470. The Use of Statistics in Sociology (3) *Professor R. E. Clark*

SPANISH

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

Sp. 544. Neo-Classicism in the Romance Literatures (3).—The nature and development of the Neo-classic movement in Italy, France, Spain, and Portugal. Prerequisite: Sp. 40. Lecture 3 hours.

Sp. 545. Romanticism in the Romance Literatures (3).—The nature and development of the Romantic movement in Italy, France, Spain, and Portugal. Prerequisite: Sp. 40. Lecture 3 hours.

Sp. 551. Romance Philology (3).—Historical development of the Romance languages. Recitation 3 hours. *Professor H. H. Arnold*

Sp. 552. Old Spanish Readings (3).—Familiarizes the student with Old Spanish texts. Prerequisite: Sp. 551. Recitation 3 hours. *Professor P. R. Daughtery*

Sp. 561. Spanish Drama Previous to Lope de Vega (3).—Origin and early development of the Spanish national drama. Representative plays of different types will be read and discussed. Lectures and reports. Recitation 3 hours. *Professor H. H. Arnold*

Sp. 562. Spanish Drama Previous to Lope de Vega (3).—Continuation of Sp. 561. Recitation 3 hours. *Professor H. H. Arnold*

Sp. 565. Lope de Vega (3) *Professor H. H. Arnold*

Sp. 566. Lope de Vega's Followers (3) *Professor H. H. Arnold*

Sp. 567. Cervantes and His Works (3) *Professor P. R. Daugherty*

Sp. 568. Cervantes and His Works (3) *Professor P. R. Daugherty*

Sp. 571. Seminar in Spanish Literature (3).—Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor. Recitation 3 hours. *Professor H. H. Arnold*

Sp. 572. Seminar in Spanish Literature (3).—Continuation of Sp. 571. Recitation 3 hours. *Professor H. H. Arnold*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Sp. 401. The Golden Age (3) *Professor H. H. Arnold*
Sp. 402. Drama of the Golden Age (3) *Professor H. H. Arnold*
Sp. 403. Don Quixote (3) *Professor H. H. Arnold*
Sp. 404. Old Spanish Language and Literature (3) *Professor H. H. Arnold*
Sp. 405. Spanish Drama of the 19th Century (3) *Professor P. R. Daugherty*
Sp. 406. Contemporary Spanish Drama (3) *Professor P. R. Daugherty*
Sp. 407. The Spanish Novel of the 19th Century (3) *Professor P. R. Daugherty*
Sp. 408. The Contemporary Spanish Novel (3) *Professor P. R. Daugherty*
Sp. 409. Introduction to Latin-American Literature (3) *Professor H. H. Arnold*
Sp. 410. Introduction to Latin-American Literature (3) *Professor H. H. Arnold*
Sp. 411. Mexico: Its Language and Literature (3) *Professor P. R. Daugherty*
Sp. 412. Argentina: Its Language and Literature (3) *Professor P. R. Daugherty*
Sp. 415, 415X. Modern Spanish Lyric Poetry (3) *Professor H. H. Arnold*
Sp. 417, 417X. Spanish Literature in the Romantic Period (3) *Professor H. H. Arnold*
Sp. 421. The Teaching of Romance Languages (3)
Sp. 490. Advanced Composition (3) *Professor P. R. Daugherty*
Sp. 496. Literary Criticism in France, Italy, and Spain (3)

SPEECH

Professor Joseph F. O'Brien, M.S.
Chairman, Administrative Committee

Speech 500. Seminar in American Oratory (2-4).—The history of American oratory, with the application of critical standards to the work of specific orators. Prerequisite: 6 credits in speech, including Speech 200. *Professor J. F. O'Brien*

Speech 510. Seminar in Methods of Teaching Speech (2-4).—Problems in curriculum construction, media, and methods as met by the high school and college

teacher of speech. Consideration of speech as a unit of English, as a distinct discipline, and as an extracurricular activity. Prerequisite: 6 credits in speech, including Speech 200. *Professor J. F. O'Brien*

SPEECH 520. SEMINAR IN SPEECH SCIENCE (2-4).—A seminar in the physical and physiological bases of speech and voice; introduction to the laboratory techniques used in speech research. Prerequisite: 9 credits in speech, speech education, or psychology.

SPEECH 525. SEMINAR IN CLINICAL SPEECH PATHOLOGY (2-4).—A physiological, neurological, and psychological view of the speech process together with a critical study of modern theories and practices in clinical speech pathology. Prerequisites: Speech 490, 491.

SPEECH 540. SEMINAR IN THE PROBLEMS OF RADIO (3).—Advanced study and research in special problems in radio speech, radio production, and radio organization. Prerequisite: 6 hours of speech including Speech 200, 300, 425 or 435. Lecture 1 hour, recitation 2 hours. *Professor H. E. Nelson*

SPEECH 550. SEMINAR IN ORAL PERSUASION (2-4).—The theory of persuasion; persuasive devices and techniques; criticism and appreciation of men of political, economic, and social movements, and of contemporary public address in the light of modern theories of persuasion. Prerequisite: 6 credits in speech, including Speech 200. *Professor C. H. Schug*

SPEECH 560. PUBLIC ADDRESS (2-4).—Aids the student in becoming proficient in public platform address; emphasis on practical application of principles of persuasion, especially through composition, discussion, criticism, and delivery of the speech outline and manuscript. Prerequisite: 9 credits in speech, including Speech 200 and 550. *Professor C. H. Schug*

SPEECH 575. RESEARCH PROBLEMS IN SPEECH (1-12).—Advanced research on an individual basis in oratorical criticism, discussion techniques, persuasion, pedagogy, phonetics, speech science, and speech pathology. Prerequisite: 12 credits in speech or in speech education.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

SPEECH 400. TEACHING OF SPEECH (3) *Professor J. F. O'Brien*
SPEECH 405a,b,cS. PRACTICAL PROBLEMS IN PUBLIC AND PRIVATE SPEECH (1-3)
SPEECH 410. ENGLISH PHONETICS AND PRONUNCIATION (3) *Professor J. F. O'Brien*
SPEECH 411a,b,cS. SPEECH SCIENCE AND SPEECH ARTS (1-3)
SPEECH 412. ADVANCED SPEECH ARTS (3)
SPEECH 425. ADVANCED PRINCIPLES OF RADIO SPEECH (3) *Professor H. E. Nelson*
SPEECH 431. ANATOMY AND PHYSIOLOGY OF THE EAR AND VOCAL MECHANISMS (3)
SPEECH 435. RADIO ORGANIZATION (3) *Professor H. E. Nelson*
SPEECH 450. DISCUSSION TECHNIQUES (3) *Professor J. F. O'Brien*
SPEECH 490. SPEECH DISORDERS AND THEIR TREATMENT (3) *Professor E. T. McDonald*
SPEECH 491. CLINICAL SPEECH PRACTICUM (1-3) *Professor E. T. McDonald*

SPEECH EDUCATION

Consult Professor Eugene T. McDonald, M.Ed., D.Ed.

Speech Ed. 537. Advanced Speech Correction (1-6).—The clinical speech procedures of examination, diagnosis, and treatment. Prerequisite: Speech Ed. 437 or Speech 491. Lecture and practicum hours 1 to 6. *Professor E. T. McDonald*

Speech Ed. 540. Articulation Disabilities (3).—Speech-sound production disorders in children and adults; methods of examination, diagnosis, and treatment. Prerequisite: Speech 490 or Speech Ed. 436.

Speech. Ed. 541. The Voice and Its Disorders (3).—The physical, physiological, and psychological bases of voice production and the causes, nature, and symptoms of its disorders; current clinical methods in voice improvement demonstrated and discussed. Prerequisite: Speech Ed. 436 or Speech 490. Lecture 3 hours.

Speech Ed. 542. Stuttering and Allied Disorders (3).—Modern theories of the causes of disorders of rhythm; methods of examination, diagnosis, and treatment. Prerequisite: Speech 490 or Speech Ed. 436. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Speech Ed. 430. Problems of the Child with a Hearing Loss (3) *Professor E. T. McDonald*
Speech Ed. 432. Methods of Teaching Speech (Lip) Reading (3) *Professor Margaret Raabe*
Speech Ed. 433. Auricular Training (2) *Professor Margaret Raabe*
Speech Ed. 434. Audiometry (2) *Professor E. T. McDonald*
Speech Ed. 435. Clinical Practice with the Deaf and Hard-of-Hearing (3)
Speech Ed. 436. Speech Disabilities (3) *Professor E. T. McDonald*
Speech Ed. 437. Speech Correction (1-3) *Professor E. T. McDonald*
Speech Ed. 439X. Fundamentals of Speech Education (3)
Speech Ed. 439aX. Methods in Speech Education (3) *Professor Margaret Raabe*
Speech Ed. 440, 440X. Speech Education and Reeducation in the Elementary School (2-3) *Professor Margaret Raabe*
Speech Ed. 441S. Current Problems in Speech and Hearing (1-6)
Speech Ed. 442. Speech Pathology (3)

ZOOLOGY

Professor Edward H. Dusham, M.S., Ph.D.
Head of the Department of Zoology and Entomology

Zool. 508. Advanced Parasitology (3).—Advanced work on the structure, life cycle, and control of parasites. Prerequisites: Ent. 2, Zool. 432. Practicum 9 hours. *Professor C. C. Zeliff*

Zool. 509. Techniques in Wild Life Management (3).—The preparation of study mounts of game birds and mammals, methods of making a census, mapping

management areas, method of collecting data, and determining food habits from examination of stomach contents. Prerequisite: Zool. 546. Lecture 1 hour, practicum 6 hours. *Professor P. F. English*

Zool. 512. Seminar (1).—The review of current zoological literature. Required of graduate students majoring in zoology and entomology. Prerequisite: 12 credits in zoology or entomology. One conference per week. *Professor P. F. English*

Zool. 513. Research (1-15 per semester).—The prosecution of an assigned problem under the guidance of an instructor. Prerequisite: Zool. 410, 432, 437, 440 or 546. *Professor E. H. Dusham and Staff*

Zool. 546. The Theory of Game Management (4).—Fundamental principles underlying the management of wild game birds and mammals; the co-ordination of such management with the various land uses; the planning of preserves and other land areas. Prerequisites: Zool. 408, 420. Lecture 3 hours, practicum 3 hours. *Professor P. F. English*

Zool. 551. Fisheries Management (3).—The basic principles underlying the management of inland waters for fish production. Prerequisite: Zool. 450. Lecture 2 hours, practicum 3 hours. *Professor E. A. Lachner*

Zool. 580S. General Zoology (3).—Lectures, recitations, and laboratory work covering the more important principles in general zoology. For graduate students in education electing a major in biology or zoology. *Professor C. C. Zeliff*

Zool. 581. Advanced Invertebrate Zoology (3).—The morphology, physiology, taxonomy, and life histories of invertebrate animals. Prerequisite: Zool. 580S. *Professor C. C. Zeliff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Zool. 408. Mammology (4) *Professor P. F. English*
Zool. 410. General Limnology (3) *Professor E. A. Lachner*
Zool. 414. Herpetology (3) *Professor E. A. Lachner*
Zool. 415. The Literature of Vertebrate Zoology (1) *Professor E. A. Lachner*
Zool. 416. The Methods of Research in Zoology (2) *Professor E. A. Lachner*
Zool. 420. Game Birds (3) *Professor P. F. English*
Zool. 432. Human Parasitology (3) *Professor C. C. Zeliff*
Zool. 436. Protozoology (3) *Professor C. C. Zeliff*
Zool. 437. Histology (4) *Professor G. B. Newman*
Zool. 440. Embryology (4) *Professor G. B. Newman*
Zool. 443. Zoological Problems (3) *Professor E. H. Dusham and Staff*
Zool. 444. Zoological Problems (3) *Professor E. H. Dusham and Staff*
Zool. 445S. The Identification of Insects (3)
Zool. 447. Aquiculture (2) *Professor E. A. Lachner*
Zool. 448. Ornithology (3) *Professor M. Wood*
Zool. 450. Ichthyology (4) *Professor E. A. Lachner*

The Pennsylvania State College Bulletin

ANNOUNCEMENT OF THE GRADUATE SCHOOL

1950 - 51

THE PENNSYLVANIA STATE COLLEGE BULLETIN

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The Pennsylvania State College Bulletin



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COLLEGE CALENDAR

1950 — *Summer Program 1950*

June 13, Tues.	Registration for Inter-Session and First Six Weeks' Science Session in a.m.
June 13, Tues.	Inter-Session and First Six Weeks' Science Session Classes Begin 1:20 p.m.
June 30, Fri.	Inter-Session Ends 5:50 p.m.
July 4, Tues.	Independence Day Recess
July 5, Wed.	Registration for Main Summer Session
July 6, Thurs.	Main Summer Session Classes Begin 8 a.m.
July 22, Sat.	First Six Weeks' Science Session Ends 5:50 p.m.
July 22, Sat.	Registration for Second Six Weeks' Science Session
July 24, Mon.	Second Six Weeks' Science Session Classes Begin 8 a.m.
Aug. 11, Fri.	Main Summer Session Ends 5:50 p.m.
Aug. 12, Sat.	Main Summer Session Graduation Exercises
Aug. 14, Mon.	Registration for Three Weeks' Post-Session in a.m.
Aug. 14, Mon.	Three Weeks' Post-Session Classes Begin 1:20 p.m.
Sept. 2, Sat.	Second Six Weeks' Science Session and Three Weeks' Post Session End 5:50 p.m.
Sept. 2, Sat.	Second Summer Program Graduation Exercises

1950 — *First Semester 1950-51*

Sept. 18-19, Mon.-Tues.	First Semester Registration
Sept. 20, Wed.	First Semester Classes Begin 8 a.m.
Nov. 22, Wed.	Thanksgiving Recess Begins 11:50 a.m.
Nov. 27, Mon.	Thanksgiving Recess Ends 8 a.m.
Dec. 19, Tues.	Christmas Recess Begins 5 p.m.

1951

Jan. 3, Wed.	Christmas Recess Ends 1:10 p.m.
Jan. 18, Thurs.	First Semester Classes End 5 p.m.
Jan. 27, Sat.	First Semester Ends 5 p.m.
Jan. 27, Sat.	First Semester Graduation Exercises

Second Semester 1950-51

Feb. 6-7, Tues.-Wed.	Second Semester Registration
Feb. 8, Thurs.	Second Semester Classes Begin
Mar. 21, Wed.	Spring Recess Begins 5 p.m.
Mar. 28, Wed.	Spring Recess Ends 8 a.m.
May 29, Tues.	Second Semester Classes End 5 p.m.
May 30, Wed.	Memorial Day Recess
June 8, Fri.	Second Semester Ends 5 p.m.
June 11, Mon.	Commencement Day

ADMINISTRATIVE OFFICERS OF THE GRADUATE SCHOOL

James Milholland, LL.B. — *Acting President*
Frank D. Kern, M.S., Ph.D., D.Sc. — *Dean*
Adrian O. Morse, M.A. — *Assistant to the President, in Charge of Resident Instruction*
J. Orvis Keller, M.S. — *Assistant to the President, in Charge of Extension*
Samuel K. Hostetter — *Assistant to the President, in Charge of Business and Finance*
C. S. Wyand, M.A. — *Administrative Assistant to the President*
Wilmer E. Kenworthy, B.A. — *Assistant to the President, in Charge of Student Affairs*
Royal M. Gerhardt, A.E. — *Dean of Admissions; Registrar*
Clarence O. Williams, M.A., Ed.D. — *Assistant Dean of Admissions; College Examiner*
Robert E. Dengler, A.M., Ph.D. — *Secretary to the Graduate Faculty*
Betty M. Moore — *Secretary to the Dean*

EXECUTIVE COMMITTEE

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S. Lewis Land, M.S., Ph.D. — *Professor of Industrial Education*
John A. Sauer, M.S., Ph.D. — *Professor of Engineering Mechanics*
Alfred W. Gauger, M.A., Ph.D., *Professor of Fuel Technology; Director of the Mineral Industries Experiment Station*
David C. Duncan, M.A., Ph.D. — *Professor of Physics*
R. Adams Dutcher, M.S., A.M., D.Sc. — *Professor of Agricultural and Biological Chemistry*
Robert E. Dengler, A.M., Ph.D. — *Professor of Classical Languages*
Lloyd M. Jones, M.A., Ph.D. — *Professor of Physical Education*
Helen R. LeBaron, M.S., Ph.D. — *Professor of Home-Community Relationships*

COURSES OF STUDY

Frank M. Swartz, Ph.D. — *Professor of Paleontology*, Chairman
Palmer C. Weaver, M.Ed., Ph.D. — *Professor of Education*
Earl B. Stavely, B.S., E.E. — *Professor of Electrical Engineering*
Arnold J. Currier, M.S., Ph.D. — *Associate Professor of Chemistry*
Wallace E. White, M.S., Ph.D. — *Professor of Wood Technology*
Eugen C. Bischoff, M.A. — *Professor of Physical Education*
Brice Harris, M.A., Ph.D. — *Professor of English Literature*
Hazel M. Hatcher, M.S., Ph.D. — *Professor of Home Economics Education and Home-Community Relationships*

ADMISSIONS COMMITTEE

Clarence O. Williams, M.A., Ed.D.	*Assistant Dean of Admissions; College Examiner,* ex officio
Joseph E. DeCamp, A.M., Ph.D.	*Professor of Psychology*
Harold K. Schilling, M.A., Ph.D.	*Professor of Physics*

THE HEALTH SERVICE

Herbert R. Glenn, M.D.	*Director*

THE COLLEGE LIBRARY

Ralph W. McComb, M.A.	*Librarian*

GRADUATE FACULTY
1949-50

JAMES MILHOLLAND, LL.B. — *Acting President of the College*
FRANK DUNN KERN, M.S., Ph.D., D.Sc. — *Dean of the Graduate School; Professor of Botany*
EDWARD STEIDLE, E.M., D.Sc. — *Dean of the School of Mineral Industries*
GEORGE L. HALLER, M.S., E.E., Ph.D. — *Dean of the School of Chemistry and Physics*
MARION REX TRABUE, M.A., Ph.D. — *Dean of the School of Education*
CARL PETER SCHOTT, M.A., Ph.D. — *Dean of the School of Physical Education and Athletics*
HARRY PARKER HAMMOND, C.E., D.Eng., LL.D. — *Dean of the School of Engineering*
LYMAN E. JACKSON, M.S., Ph.D. — *Dean of the School of Agriculture*
BEN EUWEMA, A.M., Ph.D. — *Dean of the School of the Liberal Arts*
GRACE M. HENDERSON, M.S., Ph.D. — *Dean of the School of Home Economics*
ROYAL M. GERHARDT, A.E. — *Dean of Admissions; Registrar*
CLARENCE O. WILLIAMS, M.A., Ed.D. — *Assistant Dean of Admissions; College Examiner*
RALPH W. MCCOMB, M.A. — *Librarian*

PROFESSORS

CLIFFORD R. ADAMS, A.M., Ph.D. — *Professor of Psychology*
VERNON M. ALBERS, M.A., Ph.D. — *Professor of Engineering Research*
HERBERT RICHARD ALBRECHT, M.S., Ph.D. — *Professor of Agronomy*
HAROLD FREED ALDERFER, M.A., Ph.D. — *Professor of Political Science*
JEAN DOWNEY AMBERSON, M.A., Ph.D. — *Professor of Home Economics Education*
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ARTHUR VON KROGH ANDERSON, M.S., Ph.D. — *Professor of Physiological Chemistry*
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JOHN GELDART ASTON, M.S., Ph.D. — *Professor of Organic Chemistry; Director of the Low Temperature Laboratory*
MACLEAN MORTON BABCOCK, M.S. — *Professor of Industrial Engineering*
ADAM LELAND BEAM, M.S. — *Professor of Dairy Production*
FREDERICK JOSEPH BEDENK, M.A. — *Professor of Physical Education*
VICTOR A. BEEDE, M.F. — *Professor of Forest Management*
FRANKLIN LEE BENTLEY, M.S. — *Professor of Animal Husbandry*
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LUTHER LEE BERNARD, Ph.D. — *Professorial Lecturer in Sociology*
ROBERT GIBBON BERNREUTER, Ph.D. — *Professor of Psychology; Director of the Psychology Clinic*
EUGEN CARL BISCHOFF, M.A. — *Professor of Physical Education*
RALPH UPSHAW BLASINGAME, B.S. — *Professor of Agricultural Engineering*
ROBERT V. BOUCHER, A.M., Ph.D. — *Professor of Agricultural and Biological Chemistry*

JOHN SCOTT BOWMAN, M.A., Ph.D. — *Professor of English Composition*
JOHN ROBERT BRACKEN, M.L.A., Ph.D. — *Professor of Landscape Horticulture*
WILLIAM CLARK BRAMBLE, M.F., Ph.D. — *Professor of Forestry*
GEORGE ELMER BRANDOW, Ph.D. — *Professor of Agricultural Economics*
R. WALLACE BREWSTER, M.A., Ph.D. — *Professor of Political Science*
HENRY SHERMAN BRUNNER, M.S., Ph.D. — *Professor of Agricultural Education*
ALBERT FRANKLIN BUFFINGTON, M.A., Ph.D. — *Professor of German*
CLARENCE EDWARD BULLINGER, I.E., M.S. — *Professor of Industrial Engineering*
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Henry R. Fortmann, M.S., Ph.D. — *Assistant Professor of Agronomy*
Phyllis R. Griess, M.A., Ph.D. — *Assistant Professor of Geography*
John C. Griffiths, M.Sc., Ph.D., D.I.C. — *Assistant Professor of Petrography*
Joseph H. Grosslight, M.A., Ph.D. — *Assistant Professor of Psychology*
Donald E. Hardenbergh, M.S. — *Assistant Professor of Engineering Mechanics*
Robert W. Higgins, Ph.D. — *Assistant Professor of Chemistry*

Theodore Kenneth Karhan, M.Ed.	*Assistant Professor of Music and Music Education*
J. Bertram Kessel, M.A., Ed.D.	*Assistant Professor of Physical Education*
Joseph Thaddeus Law, M.A.	*Assistant Professor of Political Science*
L. Larry Leonard, M.A., Ph.D.	*Assistant Professor of Political Science*
Mildred Adams Lucey, M.S.	*Assistant Professor of Physical Education*
Neil A. McNall, M.A., Ph.D.	*Assistant Professor of History*
Eugene A. Myers, M.A., Ph.D.	*Assistant Professor of Economics*
Vernon W. Myers, M.A., Ph.D.	*Assistant Professor of Physics*
Harold Elroy Nelson, M.A., Ph.D.	*Assistant Professor of Speech*
Amos Earl Neyhart, M.S.	*Administrative Head, Institute of Public Safety*
Theodore Stephen Polansky, M.S., Ph.D.	*Assistant Professor of Fuel Technology*
Margaret C. Raabe, M.S.	*Assistant Professor of Clinical Speech*
Joseph G. Rayback, M.A., Ph.D.	*Assistant Professor of American History*
Robert Reifsneider, M.A.	*Assistant Professor of Dramatics*
H. David Rix, M.S., Ph.D.	*Assistant Professor of Physics*
Roger B. Saylor, A.M., Ph.D.	*Assistant Professor of Economics*
John M. Schempf, Ph.D.	*Assistant Professor of Chemistry*
Robert W. Schiessler, M.S., Ph.D.	*Assistant Professor of Chemistry*
Warren S. Smith, M.A.	*Assistant Professor of Dramatics*
Leo H. Sommer, M.S., Ph.D.	*Assistant Professor of Chemistry*
William Spackman, Jr., M.S., Ph.D.	*Assistant Professor of Paleobotany*
Joseph Eris Steckel, Ph.D.	*Assistant Professor of Soil Technology*
Richard G. Stoner, M.A., Ph.D.	*Assistant Professor of Physics*
Shiou-Chuan Sun, M.S., Sc.D.	*Assistant Professor of Mineral Preparation*
David Van Meter, M.S.	*Assistant Professor of Electrical Engineering*
Romeo Barrick Wagner, M.S., Ph.D.	*Assistant Professor of Chemistry*
Ralph H. Wherry, M.A., C.L.U.	*Assistant Professor of Economics*
Alfred Frederick Woelfel, M.S.	*Assistant Professor of Electrical Engineering*
Kelly Yeaton, M.A.	*Assistant Professor of Dramatics*
C. Courson Zeliff, M.S., Ph.D.	*Assistant Professor of Zoology*
Harry D. Zook, M.S., Ph.D.	*Assistant Professor of Chemistry*

INSTRUCTORS

John A. DeNovo, M.A., Ph.D.	*Instructor in History*
James D. Lemley, M.S.	*Instructor in Human Nutrition Research*
Neal Riemer, M.A., Ph.D.	*Instructor in Political Science*
Frank Briscoe Stephens, M.S., Ph.D.	*Instructor in Meteorology*

THE GRADUATE SCHOOL

THE GRADUATE SCHOOL was established in 1922. Graduate instruction had been given previously under the direction of a committee of the faculty or of the College Senate. The School has general control of all questions concerning graduate work. The faculty consists of such members of the instructional staff as have immediate supervision of graduate courses.

In the Graduate School routine requirements are reduced to a minimum. So far as they exist, they are for the purpose of furnishing the discipline and methods necessary for independent study and investigation. It is the object of the School to surround the student with conditions that will enable him to devote himself to some chosen field. Advanced degrees are conferred as a mark of attainment of certain standards of scholarship.

The President of the College, on recommendation of the Dean of the Graduate School, will welcome Doctors of Philosophy of The Pennsylvania State College, as well as those of other accredited colleges and universities, as guests of the College, with the privilege of attending seminars and research courses and of carrying on research in laboratories and libraries. There will be no charge except for laboratory expenses. Arrangements should be made in advance with the Dean of the Graduate School.

ADMISSION—To be admitted to the Graduate School, an applicant must have received a baccalaureate degree from an accredited institution, earned under residence and credit conditions substantially equivalent to those required by this College. Graduates of The Pennsylvania State College must have had a minimum grade point average of 1.5 in their junior and senior years. Graduates of other institutions with different systems of grading must have had equivalent standing.

A student applying for admission, after having attended another graduate school where a substantial amount of credit has been earned, or a student whose career subsequent to graduation has been characterized by unusual attainments in fields having a bearing on his graduate qualifications, will be rated by a combination of the records submitted.

Admission is granted by the Dean of Admissions. If the applicant has attended more than one institution, an official transcript of the work covered at *each* institution is required. This applies to the complete academic record, both undergraduate and graduate. The applicant should have official credentials submitted directly from institutions to the Dean of Admissions as early as possible. A graduate of The Pennsylvania State College may present his final grade report or an official transcript of his complete record at the time he applies for admission to the Graduate School.

General inquiries regarding graduate work should be addressed to the Dean of the Graduate School. A student should not hesitate to write directly to the head of a department if he has specific questions regarding the work of that department.

CLASSIFICATION—At the time of admission all candidates must enroll as either *Regular* or *General* graduate students. The difference is as follows:

Regular Graduate Students (degree candidates)—This group includes all those who desire to become candidates for advanced degrees. Their complete status is determined and conditions of candidacy are arranged. A program is developed under the guidance of an adviser. A matriculation fee of $5 should accompany the application for admission.

General Graduate Students (nondegree candidates)—Applicants who meet all requirements for admission but who have not decided to become candidates for an advanced degree at this institution may arrange for a program of work as general graduate students. This classification is open to those who wish to transfer credit to another institution or who wish to fulfill requirements other than those of advanced degrees. An admission fee of $1 should accompany the application for admission.

If a student enrolled as a general graduate student desires to become a candidate for an advanced degree, he may do so by making application to the Dean of Admissions and by paying the $5 matriculation fee.

Not more than six credits earned as a general graduate student may be used toward the requirements for a degree.

REGISTRATION—All students must register at the beginning of each semester or summer session. Registration days are shown in the College Calendar on page 4. Graduate students are allowed one week for registration following the regular semester registration days before the late fee of $10 is imposed.

The student must prepare each term a program satisfactory to the major department or group committee. When this schedule is approved by the Dean of the Graduate School, the student completes the registration forms and pays his fees.

Under certain conditions credit may be earned by work done off the campus. Students contemplating such work should request details from the Dean of the Graduate School.

CHANGES IN THE PROGRAM—When a change in program is essential, it may be made only with the approval of the Dean of the Graduate School. If the student should make a change in his major or in the degree toward which he is working, he would also be required to make such change through the office of the Dean of Admissions, and his status would be determined at that time. A fee of $2 is charged for each change of schedule.

CREDITS AND GRADES—All grades for graduate students are reported each term to the Registrar. Instructors are asked to report grades also to the Dean of the Graduate School at the end of the term when the student is a candidate for a degree. Courses numbered in the 500 series are marked on the basis of P (pass), H (honors), or F (fail). For work taken in the 400 series a passing grade of 2 is required.

GRADUATE SCHOOL FEES

Matriculation fee (regular students)	$ 5.00
Admission fee (general students)	1.00
Incidental fee, each semester	50.00
General fixed fee, each semester	45.00
Health service fee (applicable to scholars, fellows, and graduate assistants)	7.50
Part-time fee, per credit (for less than 12 credits)	9.00
Late registration fee	10.00
Late payment or deferment fee	5.00
Change of schedule fee	2.00
Graduation fee	10.00
Transcript of record (extra copy)	1.00
Off-campus registration fee, each year	2.50

Summer session students who register for graduate courses pay the regular fees for the summer sessions.

In addition to the above fees, all full-time students who are not residents of Pennsylvania are charged a tuition fee of $110 per semester; part-time students are charged an additional $9 per credit. There is no exemption from these fees, except for scholars, fellows, and graduate assistants.

Whenever it shall appear from any of the data presented as part of the application for admission that the applicant is not a resident of Pennsylvania, the Dean of Admissions, when admission is granted to that applicant, assumes that the one admitted is a non-Pennsylvanian. A student so admitted is held liable for the out-of-State tuition fee.

If the one who is admitted believes that his circumstances do not justify his classification as a non-Pennsylvanian, he may petition the Dean of Admissions for reclassification.

Whenever such a petition for reclassification is made, the petitioner is required to present proof of bona fide continuous residence of the one admitted (or his parents, if he is a minor) within the Commonwealth for a period of not less than 12 months immediately preceding his admission; and, in addition, such other evidence as may appear pertinent to a complete review of the classification.

CANDIDACY FOR ACADEMIC AND PROFESSIONAL DEGREES

In order to be admitted to candidacy for an advanced degree, the applicant must meet in full (1) the requirements for admission to the Graduate School, (2) certain undergraduate preparation necessary for the particular major chosen, and (3) a planned program approved by the major department.

ACADEMIC DEGREES

PREREQUISITE FOR CANDIDACY—Ample undergraduate preparation in the field in which the candidate intends to carry on graduate work is required. The number of undergraduate credits required varies in different departments. Full information as to what is considered adequate in the various fields is on file in the office of the Dean of Admissions. An applicant who is deficient in preparation may under certain conditions be admitted to the Graduate School but not to candidacy for a degree until he satisfies the requirements. This does not apply to a deficiency in the 1.5 scholastic average. If there is a deficiency in this regard, the applicant will be refused admission to the Graduate School. An applicant who has been admitted to the Graduate School but who lacks the required undergraduate credits for the major chosen will be allowed to follow a program satisfactory to the major department. It is likely that his program will require more than the minimum residence.

DEGREES OF MASTER OF ARTS AND MASTER OF SCIENCE

Two degrees are conferred, Master of Arts for those proceeding in the liberal arts, and Master of Science for those proceeding in science or technology.

REQUIREMENTS—A course for the master's degree requires a minimum of 30 credits and consists of one major and not more than two minor subjects. The program requires the equivalent of one academic year (two semesters), or at least 30 weeks, and may be met by full-time residence, part-time work, attendance in the summer sessions, or by any combination of these. Students not adequately prepared, or assistants and other part-time students, will require more than this time to attain the master's degree. Three credits earned in residence at another approved institution or in the extension classes of The Pennsylvania State College under certain conditions may be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within a period of six years.

At least 12 credit hours and a thesis equivalent of 6 credits must be devoted to the major subject. Twelve credits may be offered in courses open to upper-class and graduate students (courses with 400 numbers). A student's program must be approved by the head of the major department and the Dean.

Choice of the major and minor subjects must be dependent upon adequate preparation. Except by permission of the Dean, one minor subject must be chosen in a field of study different from that of the major. The mere completion of a stated amount of work does not entitle a candidate to recommendation for a degree. He must pass examinations upon such subjects and at such times as shall be designated by the departments concerned and must present an acceptable thesis.

THESIS—Under the direction of the department in which the candidate's major subject is taken, he must prepare a thesis upon a suitable topic related to that subject. Under certain conditions a student may be permitted to complete the thesis

in absentia. To obtain such permission the student must make satisfactory arrangements both with the major department and with the Office of the Dean.

For instructions concerning the form and the filing of typewritten copies of the thesis, see page 29.

DEGREE OF DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy (Ph.D.) is conferred in recognition of high attainments and productive scholarship in some special field of learning as evidenced (1) by the satisfactory completion of a prescribed period of study and investigation; (2) by the preparation of a dissertation involving independent research; and (3) by successfully passing examinations covering both the special subject and the general field of learning of which this subject forms a part.

RESIDENCE REQUIREMENTS—A minimum of three academic years of resident graduate study and research are required for the attainment of a doctor's degree. Students not devoting full time to graduate study will be required to extend their work over a longer period. Credit for part-time work will be based on the actual time spent in the pursuit of graduate work. Work of equal grade done in residence at other institutions and residence for a master's degree may be accepted by the Dean of Admissions and the faculty as partial fulfillment of the requirements, but at least one academic year must be spent at this institution. While the minimum residence requirements must be met, it is undrstood that the time requirement is secondary to other considerations.

One-third of the residence requirements for a Ph.D. degree may be met by research work away from the College in branch laboratories of the College, or research laboratories not connected with other degree-granting institutions, or in other centers where there are opportunities for research under the following conditions:

(a) The candidate shall have had at least one year's work in residence.

(b) The plan must have the approval of the group committee.

(c) Reports on the work shall be made as directed by the group committee.

A candidate for a doctor's degree, doing graduate work off the campus, may obtain in this manner a maximum of six credits in an academic year, September to June, or nine credits in a calendar year. This does not apply to resident students temporarily assigned to other locations when, in the judgment of the Dean of the Graduate School, and the head of the department concerned, such assignment seems desirable.

Work done off the campus, which is to be credited toward a doctor's degree, must be scheduled *in advance* with the Dean of the Graduate School and the Dean of Admissions.

WORK DONE ELSEWHERE—Acceptance of residence in another institution as partial fulfillment of the requirements toward an advanced degree, shall be by authority of the Dean of Admissions. In determining to what extent the work done elsewhere may meet the course requirements at this institution each case will be

decided on its merits by the group committee, or by the Dean and the heads of the departments concerned.

PROGRAM OF WORK—A program shall consist of a major and one or two minor subjects. Two-thirds of the total time is to be devoted to the major subject. A division of the remaining one-third of the total time on the basis of two to one between the first and second minors is satisfactory. The heads of the major and minor departments or their representatives, together with the Dean, constitute a special group committee which shall have general charge of the arrangement of the program.

For the first year of graduate study leading to the doctor's degree, 30 credit hours is considered a full-time program. The first year's work may be substantially the same as that provided for the master's degree, and may lead to that degree, although that is not necessary.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department that he is prepared to proceed and is recommended by his group committee.

There is no specified number of courses or credits for the attainment of the doctor's degree. A program shall consist of such a combination of courses and research as is approved by the group committee for each individual student. Students devoting only a portion of their time will be credited on their residence requirements in proportion to the time actually spent in graduate study and research.

DISSERTATION—The ability to do independent research must be proved by the preparation of a dissertation on some topic in connection with the major subject. It should represent a contribution on some worth-while problem presented in a scholarly manner. The contents and conclusions of the dissertation must be defended at the time of the final examinations.

The general subject of the dissertation must be determined at the time of admission to candidacy for the degree, and the completed dissertation, typewritten in triplicate copy, must be filed in the office of the College Librarian not later than one week prior to the commencement at which the candidate expects to take the degree.

For regulations concerning the form and the filing of the dissertation, see page 29.

EXAMINATIONS—Preliminary or qualifying examinations are required in the major and minor subjects to determine whether the candidate has made satisfactory progress and is entitled to the privilege of completing the requirements for the degree. These examinations are scheduled at a time when one-third of the residence requirements remain to be satisfied. They are given by a committee representative of the departments concerned and such other members as the Dean may appoint. The candidate must have satisfied the language requirements before taking the preliminary examinations.

Candidates for the degree of Doctor of Philosophy are required to have a reading knowledge of French and German unless an exception is arranged. Upon the recommendation of the major department and the approval of the Dean, the substi-

tution of another foreign language may be authorized for either French or German. In the case of foreign students, German and English will commonly serve as the foreign languages, unless one of these be the mother tongue. Certificates of proficiency must be obtained from the respective language departments of this College, or from the Dean of Admissions provided language requirements have been met at another institution. Candidates not presenting certification of reading ability at the time of admission should make immediate arrangements to acquire that ability either through class work or by tutoring. The language requirements must be satisfied prior to the scheduling of the preliminary examinations. The language examinations will be administered three times each year, ordinarily between 7 and 9 p.m. on the first Monday in November, the first Monday in March, and the Monday of the fifth week of the regular Summer Session. Registration for the examinations must be completed in the respective departments no later than one month prior to the date of the examinations.

The final examination for the doctor's degree is conducted by a committee representative of the departments concerned and such other members as may be appointed by the Dean, who shall also designate the time and place. The examination is oral, open to the public, and covers the whole field of study of the candidate without regard to courses that may have been taken either here or elsewhere.

PROFESSIONAL DEGREES IN EDUCATION

PREREQUISITES FOR CANDIDACY—In order to provide graduate work which would utilize more fully the professional training and background of those holding bachelors' degrees from teachers colleges and schools of education, these professional degrees in education were established.

All candidates are required to have had at least 27 undergraduate credits in the field of education, including practice teaching. If a candidate elects to specialize in a subject-matter field, then certain additional prerequisites are required for that subject. The amount of preparation varies in the different fields. Full information concerning the preparation required by the various departments is on file in the office of the Dean of Admissions. If there are deficiencies at the time of admission they must be removed before candidacy for a degree is completed. While making up deficiencies in prerequisite credits a student must follow a program satisfactory to the major department. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School until applicants have brought up their standing by further undergraduate work.

Candidates for the advanced degrees in education are required to take a qualifying comprehensive examination before completing the second half of their course requirements, which serves as a guide in outlining a program of study that will meet the individual needs of the candidate.

DEGREE OF MASTER OF EDUCATION

The degree of Master of Education represents general scholarship, acquaintance with the chief phases of educational literature, teaching skill, qualities of leadership

in educational work, and ability to solve concrete problems in at least one special field of education.

The following regulations govern candidacy for the degree of Master of Education:

RESIDENCE AND COURSE REQUIREMENTS—A minimum of 30 credits, 6 of which may be granted for an approved thesis. The program requires the equivalent of one academic year (two semesters), or at least 30 weeks, and may be met by full-time residence, part-time work, attendance in the summer sessions, or any combination of these. Three credits earned in residence at another approved institution or in extension classes of The Pennsylvania State College, under certain conditions may be offered as partial fulfillment of the requirements. All requirements must be met within a period of six years.

A minimum of 24 credits is to be earned in graduate course work. It is expected that the larger part of this work shall be in courses open only to graduate students, but the needs of the student shall be considered in arranging the best combination of courses (400 and 500 series) for the preparation of the candidate in his special field.

If a student looks forward to a career as a teacher, he may specialize in a specific field (as English, mathematics, Latin, etc.), and that shall be regarded as the major field, and a majority of the work is to be taken there. If a broader field is sought, a group major may be chosen (as social studies, general science, etc.). In this case a larger percentage of the 24 credits is to be devoted to the subjects forming the group major. The remainder of the program is devoted to a minor in the field of education, consisting of approximately one-third of the required credits, depending on the previous preparation, experience, and objectives of the candidate. In case the candidate's undergraduate preparation has not included courses in the scientific study of education and advanced educational psychology, a course in each of these fields must be included.

Those desiring to prepare as supervisors and administrators may choose a major and a minor within the curricula of Education. The following fields are recommended: secondary school principal, elementary school principal, superintendent of schools, guidance counselor, vocational director, or supervisor.

The candidate may choose one field of work for a major and another field for a minor. These majors prepare for State certificates in those fields where special certificates are given. It is possible to arrange programs of study concentrated in other fields.

ADVISORY COMMITTEE—The heads of the major and minor departments or fields (or their representatives) together with the supervisor of the problem course (thesis) constitute a special advisory committee which shall approve the study program. In practice the general guidance of a student is centered in an adviser from the major department, who is familiar with the field in which the student is specializing.

THESIS—Under the direction of a supervisor representing the major department or major field, an amount of time equivalent to six credits may be devoted to

problem work and the preparation of a thesis. Under certain conditions this may be carried out in part *in absentia,* particularly when requirements are met by summer session attendance.

Course work may, under certain conditions, wholly or in part, take the place of the problem and thesis work. Application for the opportunity to substitute six credits of course work for the thesis must be filed with the candidate's advisory committee or adviser before the candidate completes more than 12 of the 30 credits required for the degree. The application must include the statement of the major and the titles and numbers of the courses which the candidate wishes to submit in substitution for the thesis.

For instructions concerning the form and the filing of the thesis, see page 29.

EXAMINATIONS—Candidates for the Master of Education degree must pass a final comprehensive examination. The examination will be designed to determine the ability of the candidate to apply the general, as well as the special, knowledge of his chosen field in practical situations.

DEGREE OF DOCTOR OF EDUCATION

The degree of Doctor of Education is conferred in recognition of scholarship and teaching or administrative skill as evidenced by (1) the satisfactory completion of a prescribed period of study, (2) the application of scientific principles in classroom teaching, in the supervision of instruction, or in administrative work, (3) by the preparation of a dissertation demonstrating ability to attack an educational problem with originality and independent thought, (4) by successfully passing examinations showing a satisfactory grasp of the field of specialization and its relation to allied subjects, and (5) by recognized leadership in the profession of education.

RESIDENCE—An equivalent of three years of graduate study is required as a minimum for the doctor's degree. However, it is not required that the three years be continuous. Graduate study may be carried on through a longer period and paralleled by teaching or administrative work.

Work of equal grade done in residence at other institutions, and residence for a master's degree, may be accepted as partial fulfillment of the requirements, but in addition at least one academic year or its equivalent must be spent in residence at this institution. For students pursuing work beyond the master's degree a combination of sessions amounting to at least 30 weeks is regarded as the equivalent of an academic year. While it may be possible to fulfill the minimum residence requirement as just stated, it is expected that candidates for the doctorate will be taking a much greater amount of work in the institution. Those completing requirements in summer sessions will continue during the regular school year in some educational situation, under the guidance of members of the faculty, study and research programs set up in summer courses.

One-third of the requirements (equivalent to a 30-credit year) for the degree of Doctor of Education may be met by research work pursued away from the campus in the school systems of the State, or in other approved centers not connected with degree-granting institutions, provided (1) the plan be approved by the student's

advisory committee, (2) reports on the projects be made as directed by the advisory committee, (3) not more than six credits be earned in an academic year, September to June, or nine credits in a calendar year.

Work done off the campus, which is to be credited toward a doctor's degree, must be scheduled *in advance* with the Dean of the Graduate School and the Dean of Admissions.

PROGRAM OF STUDY—The program of study shall be so arranged as to lead toward high professional mastery within some area of educational service. A majority of the courses offered in fulfillment of the requirement will be in the major field of study. The remainder shall be in one or two minors bearing some functional relation to the major and to the work the candidate is planning to do. These minors may be in academic subjects or in some phase of education or psychology other than the major. In the case of persons intending to continue in classroom teaching rather than in administrative or supervisory positions, a larger proportion of the work may be assigned to the academic fields in which the candidate is teaching, to whatever extent the advisory committee may believe the background and the objectives of the particular candidate warrant. But every candidate for the degree of Doctor of Education must show through a comprehensive examination that he is familiar with current theories of education; that he understands and can apply the techniques and the findings of educational research so far as they bear upon the teaching of his subject; that he is prepared to read understandingly, and to contribute to, the technical professional literature in his field; and that he can criticize his own procedures in the light of historical trends and practices in this and other countries.

Command of the tools for a thorough study of the problems of education is necessary and must include familiarity with statistical methods. For certain students the requirements may include a reading knowledge of one or more foreign languages.

There is no specified number of courses or credits for the attainment of the doctor's degree. The general requirements are based not upon courses or credits but upon a definite residence, a satisfactory dissertation, the passing of a comprehensive examination, and possession of the qualities of professional leadership. A program shall consist of such a combination of courses and individual study and research as is approved by the advisory committee for each student.

ADVISORY COMMITTEE—The heads of the major and minor departments or fields (or their representatives), the supervisor of the dissertation, together with the Dean of the Graduate School, constitute a special advisory committee which shall have charge of the arrangement of the study program.

DISSERTATION—Evidence of a high degree of scholarship and ability to select, organize, and apply knowledge must be presented by the candidate in the form of a written dissertation. The candidate must demonstrate capacity for independent thought and ability and originality in the application of educational principles or in the development of new generalizations under scientific controls. The topic and outline of the proposed thesis must have the approval of the advisory committee.

For instructions concerning the form and filing of the dissertation, see page 29.

EXAMINATION AND ADMISSION TO CANDIDACY—In order to be admitted to full candidacy for the degree each candidate shall pass preliminary qualifying examinations administered by the committee on qualifying examinations. The qualifying examinations may not be taken until after one semester of work has been completed at this institution. They are scheduled at a time when one-third of the residence requirements remain to be satisfied. Examinations will be held at times arranged with the head of the major department. The qualifying examinations will be designed to test (1) the candidate's general scholastic preparation and professional background; and (2) his ability to integrate and apply his knowledge in his fields of specialization to practical situations so as to reflect an intelligent mastery of the subjects.

Three of the important factors taken into consideration in passing judgment upon the application of a candidate for admission to candidacy are:

(a) Previous scholastic record at this institution and other institutions attended;

(b) Achievement in qualifying examinations;

(c) Estimates of his personal and professional qualifications by members of the advisory group.

The advisory committee will make recommendations to the Dean of the Graduate School, and the candidates will be advised of the decision with regard to their applications for candidacy within 10 days following the date of each qualifying examination.

A candidate who has fulfilled all other requirements for the degree will, on recommendation of his advisory committee, be permitted to take the final oral examination for the degree. The committee in charge of this examination will consist of the student's advisory committee and others appointed by the Dean of the Graduate School. The examination will be based upon the dissertation and related problems. Arrangements for taking the final examination must be made with the Dean of the Graduate School, through the advisory committee and the major department, not later than two weeks prior to a commencement date.

PROFESSIONAL DEGREE IN FORESTRY

The degree of Master of Forestry represents scholastic ability, acquaintance with forestry literature, and technical knowledge of one or more of the several specialized fields in forestry or wood utilization. It is offered to provide an opportunity for additional study in a student's particular field of interest, rather than for research work on a special problem, though such work is not precluded under the requirements for the degree.

PREREQUISITES FOR CANDIDACY—A candidate is required to hold a baccalaureate degree, or its equivalent, from a recognized professional school of forestry. Full information concerning the preparation required in either general forestry or wood utilization is on file in the office of the Dean of Admissions. If there are deficiencies at the time of admission they must be removed before candidacy for a degree is completed. While making up deficiencies in prerequisite credits,

the student must follow a program approved by his advisory committee. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School.

RESIDENCE AND COURSE REQUIREMENTS—A minimum of 30 credits is required for the degree of Master of Forestry. These credits are to be taken in the best arrangement of courses bearing 400 and 500 numbers suited to the needs of the individual student. Although not required, a maximum of 6 credits may be assigned to a thesis upon approval and recommendation of the head of the Forestry Department. All requirements must be met within a six-year period.

A maximum of three credits may be earned in extension classes of The Pennsylvania State College, or in resident classes of other approved institutions, provided these credits have the approval of the Dean of Admissions and fit into the program of the student.

A student should choose one field of work for his major interest with one or two related minor fields. The proportion of credits to be taken in the major and minor fields of study will be determined in consultation with an advisory committee. Ordinarily this committee consists of the head of the Forestry Department and the professors in charge of the major and minor fields.

TECHNICAL DEGREES

ADMISSION—A graduate of the School of Chemistry and Physics, of the School of Engineering, or of the School of Mineral Industries of The Pennsylvania State College may be admitted to candidacy for a technical degree, provided he submits evidence of having been engaged for a period of not less than three years in acceptable professional work in the field of engineering in which the application for the degree is made.

A technical degree may also be granted to an engineer of approved practical experience, who is a graduate in engineering of another institution of equal standing, on completion of at least three years of full-time teaching or research work in engineering in a professorial rank in this institution and upon presentation of an acceptable thesis and the fulfillment of all other requirements for technical degrees. An applicant who is eligible for a technical degree is admitted to the Graduate School by the Dean of Admissions.

REGISTRATION—A candidate for a technical degree must file with the Dean of Admissions an application filled out in duplicate on the prescribed forms, approved by the head of the department in which the undergraduate work was completed. The application should be accompanied by the matriculation fee of $5.

Registration for these degrees is the same as for resident students. A candidate must be registered during two regular semesters.

DEGREES AND REQUIREMENTS—The technical degrees are as follows: Architectural Engineer, Chemical Engineer, Civil Engineer, Electrical Engineer,

Fuels Engineer, Industrial Engineer, Ceramic Engineer, Mechanical Engineer, Engineer of Mines, Metallurgical Engineer, Petroleum Engineer.

Not less than three years shall have elapsed from the time of receiving the first degree before a graduate of this institution shall be permitted to file his application for a technical degree. The application for a technical degree shall include evidence of a satisfactory professional record, which must be approved by the executive committee of the undergraduate School concerned.

In order to be recommended for a technical degree the candidate must prepare a thesis on a subject related to his profession. He must register in the manner specified in the foregoing paragraph and pay the registration and diploma fees. He may be required to appear in person to defend his thesis.

THESIS—Immediately following registration the candidate must submit for approval an outline of his proposed thesis, and at least six weeks prior to the day on which the degree is to be conferred, the complete thesis must be in the office of the head of the department concerned.

For regulations concerning the form and filing of the thesis, see below.

FEES—Each candidate for a technical degree must pay a matriculation fee of $5 and a diploma fee of $10 when recommended to the College Senate for the degree. Fees are payable by check drawn to the order of The Pennsylvania State College. The matriculation fee is sent to the Dean of Admissions, the diploma fee to the Bursar.

REGULATIONS FOR THESES AND DISSERTATIONS

It is required that three typewritten copies of theses and dissertations be presented. They are due in the office of the College Librarian not later than one week prior to the day on which the degree is to be conferred.

Before arranging for the typing, the candidate must obtain information from the College Librarian concerning the format, paper, illustrations, etc.

A thesis for a master's or a technical degree thus submitted and approved becomes wholly the property of the College, and may not be published, in whole or in part, without authorization of the Dean of the Graduate School and the head of the department concerned.

These regulations apply to candidates for the master's and technical degrees.

A candidate for a doctor's degree must satisfy also one of the following requirements as to the dissertation not later than one week prior to the day on which the degree is to be conferred:

1. Publication of the dissertation in a manner satisfactory to the College Librarian and deposit of 100 copies in the College Library; or

2. Presentation of a typewritten abstract, satisfactory to the major department and the College Librarian and the sum of $35. The Librarian will then arrange for the printing of the abstract. Fifty copies of the printed abstract will be furnished to the candidate without additional cost.

GRADUATE ASSISTANTSHIPS AND OTHER AIDS

A number of appointments as assistants in teaching or research work, or awards as fellows, or scholars, are available with varying stipends and exemption from the incidental fee, the general fixed fee, and the out-of-State tuition fee. A health service fee of $7.50 is assessed, from which there is no exemption. The application for appointment should be made to the head of the department in question. The graduate program that can be carried is proportioned to the service rendered.

GRADUATE ASSISTANTSHIPS—Appointments for 9 months, September 15 to June 15 (stipend $1008), or for the fiscal year (stipend $1344); service one-half time; program two-thirds.

SPECIAL GRADUATE ASSISTANTSHIPS—Appointments for 9 months (stipend $1512), or for the fiscal year (stipend $2016); service three-fourths time; program one-half.

GRADUATE STIPEND SCHOLARSHIPS—Appointments for 9 months (stipend $504), or for fiscal year (stipend $672); service one-fourth time; program four-fifths.

DU PONT FELLOWSHIP IN CHEMISTRY—Candidate recommended by the Department of Chemistry and approved by a member of the fellowship committee of the du Pont Company (stipend $750).

RESEARCH AND INDUSTRIAL FELLOWSHIPS—Numerous fellowships offered by various outside agencies for the investigation of special problems (stipends vary). Information is obtainable from the departments.

THE JOHN W. WHITE FELLOWSHIPS—Awarded to two graduates of The Pennsylvania State College each year on the basis of scholarship, need, character, and attitude.

THE ELLIOTT FELLOW IN ENGINEERING RESEARCH—An annuity provided by W. S. Elliott, of Pittsburgh, for a student in engineering who must be a graduate of this College.

GRADUATE SCHOLARSHIPS—A limited number of scholarships without stipends, but with exemption from the incidental, general fixed, and out-of-State tuition fees, are assigned to the various departments. The holder is required to render some service, but a master's degree may be earned on the basis of one academic year. Application may be made to the Dean of the Graduate School, or to the head of the department in question.

GRADUATE COURSES

The course descriptions which follow are arranged alphabetically according to departments. If any specific course cannot be located readily, refer to the table of contents, pages 2 and 3.

The courses of instruction in all departments of the College are numbered in accordance with a unified plan, as follows:

UNDERGRADUATE COURSES, numbered 1 to 399, are general courses accepted in fulfillment of the requirements for the bachelor's degree.

UPPER-CLASS AND GRADUATE COURSES, numbered 400 to 499, are advanced courses open for credit to undergraduate students of at least junior standing and to graduate students under the restriction that no more than 12 credits in these courses may be offered in fulfillment of the requirements for the degrees of M.A. and M.S.

GRADUATE COURSES, numbered 500 to 599, are special courses for graduate students only. The name of the person in charge of the instruction for the course usually follows the description. Senior students of The Pennsylvania State College not required to carry a full program for graduation, with permission of the Dean of the School in which they are enrolled and of the Dean of the Graduate School, may attend such courses and be allowed credit under special conditions. *Many departments reserve the right to say which of certain graduate courses may be given in any semester; the heads of departments should be consulted.*

The figures in parentheses following the title of the course indicate the number of credits granted for that course. A considerable number of graduate courses are offered in the summer sessions. When these courses are also given during the regular academic year they are not listed separately as summer session courses in this announcement. For a complete list of courses given during a specific summer or summer session, consult the *Complete Announcement of the Summer Sessions* for that particular year. In this announcement courses given during the summer session *(but not during the regular academic year)* have numbers followed by the letter "S." Courses given in extension only have numbers followed by the letter "X."

AERONAUTICAL ENGINEERING

PROFESSOR DAVID J. PEERY, M.S.E., C.E., Ph.D.
Head of the Department

AERO.E. 501. AIRPLANE STABILITY AND CONTROL (3) General analysis of longitudinal and lateral stability of airplanes; characteristics of flight control devices. Prerequisite: Aero.E. 403. Lecture 3 hours.

AERO.E. 502. AIRCRAFT PROPELLER DESIGN (3) Propeller characteristics by blade element analysis and test data; blade design and stress analysis; pitch changing mechanisms. Prerequisites: Aero.E. 403, M.E. Des. 6, 8. Lecture 3 hours.

AERO.E. 503. AIRPLANE PERFORMANCE (3) Analytical approach to airplane performance problems; reduction of flight test data. Prerequisite: Aero.E. 403. Lecture 3 hours.

AERO.E. 504. ROTARY WING AIRCRAFT (3) Types of rotary wing aircraft, rotor arrangements, power transmission, and control mechanisms; helicopter performance in vertical and forward flights; dynamic and aerodynamic loads on rotor blades. Topics are treated in more detail and at higher level than in Aero.E. 407. Prerequisites: Aero.E. 403, 409. Lecture 3 hours.

AERO.E. 505. AIRCRAFT VIBRATION AND FLUTTER (3) Vibrating systems with several degrees of freedom; analysis of flutter speed of an airplane wing considering bending, torsion, and aileron motions; other types of aircraft flutter. Prerequisites: Aero.E. 1, M.E. Des. 8. Lecture 3 hours.

AERO.E. 506. ADVANCED AIRCRAFT STRUCTURES (3) Deflections of beams and trusses; statically indeterminate structures; shear-flow analysis and shearing deformations of multi-cell semi-monocoque structures; effects of discontinuities in wing and fuselage structures. Prerequisite: Aero.E. 409. Lecture 3 hours.

AERO.E. 507. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3) History and theory of gas turbines for propeller and jet propulsion installations; theoretical and design analysis of various combinations of the basic elements; compressor, combustion chamber, and turbine. Topics are treated in more detail and at higher level than in Aero.E. 408. Prerequisite: M.E. 413. Lecture 2 hours, practicum 3 hours.

AERO.E. 508. ADVANCED AIRCRAFT ENGINE DESIGN I (4) Fundamental principles of design of aircraft engines; performance and stress computations. Assembly drawings of a complete engine are started. Prerequisite: M.E. 413. Lecture 2 hours, practicum 6 hours.

AERO.E. 509. ADVANCED AIRCRAFT ENGINE DESIGN II (4) Continuation of stress computations and assembly drawings begun in Aero.E. 508; completion of design report. Prerequisite: Aero.E. 508. Lecture 2 hours, practicum 6 hours.

AERO.E. 510. AERODYNAMICS OF COMPRESSIBLE FLUIDS (3) One-dimensional motion, shock waves, flow through nozzles and other channels; airfoils in high-speed flow, critical Mach number; subsonic, transonic, and supersonic regions. Prerequisites: Aero.E. 1, Math. 84, M.E. 2. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AERO.E. 401a,b,c. AERONAUTICAL ENGINEERING PROJECTS (2-12)
AERO.E. 402. AIRPLANE ENGINE DESIGN (4)
AERO.E. 403. APPLIED AERODYNAMICS (3)
AERO.E. 404. AIRPLANE DESIGN (4)
AERO.E. 407. ROTARY WING AIRCRAFT (3)
AERO.E. 408. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3)
AERO.E. 409. AIRPLANE DETAIL DESIGN (3)

AERO.E. 410. AIRCRAFT PROPULSION (3)
AERO.E. 411. AIRCRAFT STRUCTURES (3)

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

PROFESSOR R. ADAMS DUTCHER, M.S., A.M., D.Sc.
Head of the Department

AGR. BIOCHEM. 501. ENZYMES (2) Investigations and theories concerning nature of enzymes, enzyme action, influence of chemical environment on enzyme action, and biological applications. Prerequisite: Agr. Biochem. 437. Lecture 2 hours.
Professor C. O. Jensen

AGR. BIOCHEM. 502. PHYSICAL CHEMISTRY OF THE CELL (3) Lectures and assigned reading reviewing current literature relative to physical chemistry of living tissues and life processes. Prerequisite: Agr. Biochem. 426. Lecture 3 hours.
Professor M. W. Lisse

AGR. BIOCHEM. 503. RESEARCH (3-15) The prosecution of an assigned problem under the guidance of an instructor. Prerequisite: Agr. Biochem. 417. For certain problems additional courses may be considered as prerequisite.
Professor R. A. Dutcher and Staff

AGR. BIOCHEM. 504. THESIS RESEARCH (3-15 per semester)
Professor R. A. Dutcher and Staff

AGR. BIOCHEM. 505. VITAMINS AND DIETARY DEFICIENCY DISEASES (2) Lectures, conferences, and assigned reading. Prerequisite: Agr. Biochem. 437.
Professor R. A. Dutcher

AGR. BIOCHEM. 506. VITAMIN ASSAY METHODS (2) Lectures, conferences, and demonstrations dealing with approved methods of vitamin assay and including demonstrations of typical vitamin deficiency syndromes in the rat. Prerequisite: Agr. Biochem. 505. *Professor N. B. Guerrant*

AGR. BIOCHEM. 507a. SEMINAR IN PHYSIOLOGICAL CHEMISTRY AND NUTRITION (1)
Professors R. A. Dutcher, N. B. Guerrant, A. K. Anderson, R. V. Boucher, R. C. Miller, G. H. Pritham

AGR. BIOCHEM. 507b. SEMINAR IN FOODS AND ANALYTICAL CHEMISTRY (1)
Professors H. O. Triebold, P. M. Althouse

AGR. BIOCHEM. 507c. SEMINAR IN PLANT, SOIL, AND INSECTICIDE CHEMISTRY (1)
Professors D. E. H. Frear, C. O. Jensen

AGR. BIOCHEM. 508. RESEARCHES IN PLANT CHEMISTRY (3) Lectures and assigned readings reviewing the more important chemical investigations in plant chemistry. Prerequisite: Agr. Biochem. 437. Lecture 3 hours. *Professor C. O. Jensen*

AGR. BIOCHEM. 509. BIOCHEMICAL METHODS (3) An advanced laboratory course involving special methods used in biochemical research on plant and animal materials. Prerequisite: Agr. Biochem. 437. Practicum 9 hours.
Professor A. K. Anderson

AGR. BIOCHEM. 510. PROTEINS (2) The chemical constitution of proteins, their physical and biochemical properties, their function in nutrition, and their fate in metabolism. Prerequisite: Agr. Biochem. 437. Lecture 2 hours.
Professor A. K. Anderson

AGR. BIOCHEM. 511. CARBOHYDRATES (2) Study of research work dealing with the carbohydrates and their metabolism in the plant and animal organisms. Prerequisite: Agr. Biochem. 437. Lecture 2 hours. *Professor C. O. Jensen*

AGR. BIOCHEM. 512. LIPIDS (2) Investigations on the biochemistry of fats and related substances. Prerequisite: Agr. Biochem. 437. Lecture 2 hours.
Professor H. O. Triebold

AGR. BIOCHEM. 513. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (4) Laboratory course, quantitative in nature, valuable as preparation for Agr. Biochem. 502. Hydrogen-ion concentration, electrometric titration, buffers, oxidation-reduction potential, and membrane potential. Prerequisite: Agr. Biochem. 425 or Chem. 41, 43. Lecture 2 hours, practicum 6 hours.
Professor M. W. Lisse

AGR. BIOCHEM. 514. PHYSICOCHEMICAL MEASUREMNETS USED IN BIOLOGICAL RESEARCH (3) Continuation of Agr. Biochem. 513. *Professor M. W. Lisse*

AGR. BIOCHEM. 515. BIOMETRY (2) The application of statistical methods to research problems in biochemistry and biology. Prerequisites: Agr. Biochem. 437, Math. 30. *Professor R. C. Miller*

AGR. BIOCHEM. 516. CHEMISTRY OF INSECTICIDES AND FUNGICIDES (2) Lectures and assigned readings dealing with chemical investigations of materials used in the control of insects and plant diseases. Prerequisites: Chem. 30, 31; Agr. Biochem. 425 or Chem. 41, 43; Agr. Biochem. 417. Lecture 2 hours.
Professor D. E. H. Frear

AGR. BIOCHEM. 517. ENDOCRINE SECRETIONS (2) Chemistry of hormones and their physiological significance. Prerequisite: Agr. Biochem. 437. Lecture 2 hours.
Professor G. H. Pritham

AGR. BIOCHEM. 518. MINERAL METABOLISM (2) Utilization and function of the mineral elements in animal nutrition. Prerequisite: Agr. Biochem. 437. Lecture 2 hours. *Professor R. V. Boucher*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. BIOCHEM. 403. DAIRY CHEMISTRY (3) *Professor H. O. Triebold*
AGR. BIOCHEM. 404. FOOD CHEMISTRY (4) *Professor H. O. Triebold*
AGR. BIOCHEM. 405S. BIOLOGICAL CHEMISTRY FOR TEACHERS OF HIGH SCHOOL SCIENCE (3)

AGR. BIOCHEM. 413. PRINCIPLES OF ANIMAL NUTRITION (3) *Professor R. C. Miller*

AGR. BIOCHEM. 417. METHODS OF AGRICULTURAL ANALYSIS (4) *Professor H. O. Triebold*

AGR. BIOCHEM. 418. PLANT ANALYSIS (4) *Professor C. O. Jensen*

AGR. BIOCHEM. 421. CHEMISTRY OF MILLING AND BAKING (3) *Professor H. O. Triebold*

AGR. BIOCHEM. 425. BIOPHYSICAL CHEMISTRY (4) *Professor M. W. Lisse*

AGR. BIOCHEM. 426. BIOCOLLOIDS (3) *Professor M. W. Lisse*

AGR. BIOCHEM. 427. POTENTIOMETRIC THEORY AND TECHNIQUE (3) *Professor M. W. Lisse*

AGR. BIOCHEM. 437. GENERAL BIOCHEMISTRY (5) *Professor G. H. Pritham*

AGR. BIOCHEM. 438. PHYSIOLOGICAL CHEMISTRY (CLINICAL METHODS) (5) *Professors A. K. Anderson, G. H. Pritham*

AGR. BIOCHEM. 439. PROBLEMS IN AGRICULTURAL CHEMISTRY (3-5) *Professor R. A. Dutcher and Staff*

AGR. BIOCHEM. 440. PLANT BIOCHEMISTRY (3) *Professor C. O. Jensen*

AGRICULTURAL ECONOMICS

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.

Head of the Department of Agricultural Economics and Rural Sociology

AGR. EC. 500. SEMINAR IN AGRICULTURAL ECONOMICS (1-6) A review of current literature and problems. Lecture 1 hour per credit.

AGR. EC. 502. ECONOMIC PROBLEMS IN THE MARKETING OF FRUITS AND VEGETABLES (3) Economics of marketing fruits and vegetables in fresh and processed form; comparative advantage of various areas of production, consumption trends, costs and methods of distribution, influence of governmental policies, and types of marketing organizations. Conference 3 hours. *Professor W. A. Lee*

AGR. EC. 503. RESEARCH METHODS IN FARM MANAGEMENT (1-3) Evaluation of research procedures, methods, results, and needs in the field; emphasis on their application to specific research problems. Prerequisites: Agr. Ec. 6, Econ. 14. Recitation 1 to 3 hours.

AGR. EC. 504. AGRICULTURAL PRICE AND INCOME POLICY (3) Analysis of farm prices, income consequences for producers and consumers, and effects on resource use; evaluation of policy, considerations in policy making. Prerequisites: Agr. Ec. 420, Econ. 402, 403. Conference 3 hours. *Professor G. E. Brandow*

AGR. EC. 505. ADVANCED AGRICULTURAL STATISTICS (3) Application to problems in rural social sciences of methods of sampling, measures of relationship, techniques of prediction, and tests of statistical significance. Prerequisite: 3 credits in statistics. Lecture 3 hours. *Professor G. E. Brandow*

AGR. EC. 507. SEMINAR IN FARM MANAGEMENT (1-6) Special problems relating to the organization and operation of the farm business. Prerequisites: Agr. Ec. 6, Econ. 14.

AGR. EC. 515. ECONOMIC PROBLEMS IN THE MARKETING OF DAIRY PRODUCTS (3) Economic problems as they are encountered in the process of marketing; particular attention to governmental regulation in pricing and marketing.
Professor C. W. Pierce

AGR. EC. 517. PROBLEMS AND POLICIES OF FARMER CO-OPERATIVES (3) Specific types of co-operative organizations, their problems, policies, and progress; relationships existing among co-operatives, between co-operatives and other business organizations, and between co-operatives and the public. Prerequisite: Agr. Ec. 17. Lecture 3 hours. *Professor J. K. Stern*

AGR. EC. 525. RESEARCH METHODS IN RURAL SOCIAL SCIENCES (2) The scientific method in planning and conducting research in agricultural economics and rural sociology; interviewing, use of questionnaires, qualitative analysis, quantitative analysis, sampling, control groups, scales, indices, and thesis writing. Prerequisite: 9 credits in social science. Lecture 2 hours. *Professor M. E. John*

AGR. EC. 533. ECONOMIC PROBLEMS IN THE MARKETING OF POULTRY AND EGGS (3) Detailed treatment of special problems such as the marketing of particular types and grades of products, the operation of certain markets, and the performance of selected marketing functions. Prerequisites: Econ. 14, P.H. 1. Recitation 3 hours.
Professor C. A. Becker

AGR. EC. 540. THESIS IN AGRICULTURAL ECONOMICS (6) The preparation of the required thesis for the degree of Master of Science in agricultural economics while in residence at the College.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. EC. 400, 400X. PUBLIC POLICIES IN AGRICULTURE (1-2)
AGR. EC. 404. FARM FINANCE (2) *Professor L. F. Miller*
AGR. EC. 405. STATISTICS APPLIED TO THE RURAL SOCIAL SCIENCES (3) *Professor G. E. Brandow*
AGR. EC. 407. ADVANCED FARM MANAGEMENT (3) *Professor L. F. Miller*
AGR. EC. 420. AGRICULTURAL PRICES (3) *Professor G. E. Brandow*
AGR. EC. 421. LAND ECONOMICS (3) *Professor W. E. Keepper*

AGRICULTURAL EDUCATION

PROFESSOR HENRY S. BRUNNER, M.S., Ph.D.
Head of the Department

AGR. ED. 501V. HISTORY OF AGRICULTURAL EDUCATION (1-3) Development of training for agricultural vocations; emphasis upon introduction of agricultural instruction into the high school program. Lecture 1 to 3 hours. *Professor W. F. Hall*

AGR. ED. 502v, 502vX. TEACHING VOCATIONAL AGRICULTURE (1-3) Organization of instruction with respect to vocational objectives, methods of presentation, supervision of practice, pupil evaluation of goals, and follow-up. Lecture and conference 1 to 3 hours.

AGR. ED. 503v, 503vX. RESEARCH IN AGRICULTURAL EDUCATION (1-6 per semester) Individual study problems in various phases of agricultural education, such as evaluation of teaching, teaching procedures, and teacher preparation. Conferences.
Professor H. S. Brunner and Staff

AGR. ED. 504v. AGRICULTURAL EDUCATION SEMINAR (1 per semester)
Professor H. S. Brunner and Staff

AGR. ED. 506v, 506vX. PROBLEMS IN COUNTY VOCATIONAL SUPERVISION (1-3) Needs of county supervisors and vocational directors; co-operation with county superintendents, supervisory duties, plans of work, community meetings and organizations. Lecture 1 to 3 hours. *Professor W. F. Hall*

AGR. ED. 508v. STATE AND COUNTY ADMINISTRATION AND SUPERVISION OF AGRICULTURAL EDUCATION (1-3) Organization and administration of state, county, township, and district systems of agricultural education; state and federal legislation. Lecture 1 to 3 hours. *Professor H. S. Brunner*

AGR. ED. 509v, 509vX. TEACHER TRAINING IN AGRICULTURAL EDUCATION (1-6) Construction of college curricula, courses of study, and organization of college departments for the training of agricultural teachers. Lecture 1 to 6 hours.
Professor C. S. Anderson

AGR. ED. 520v, 520vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Methods of procedure in investigation and experimentation in education, accompanied by a critical examination of studies made in agricultural education. Lecture 1 to 4 hours. *Professor H. S. Brunner*

AGR. ED. 521v, 521vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Continuation of AGR. ED. 520v; emphasis upon the statistical techniques for students' individual problems. Lecture 1 to 4 hours.
Professor W. F. Hall

AGR. ED. 522v, 522vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) Organization and administration of agricultural education in its local bearings; field laboratory surveys of local school conditions. *Professor H. S. Brunner and Staff*

AGR. ED. 523v, 523vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4)
Professor H. S. Brunner and Staff

AGR. ED. 524v, 524vX. ANNUAL PLAN OF WORK (1-3) A detailed study of the agricultural education needs of each student's community and the outlining of annual plans of work. Lecture 1 to 3 hours. *Professor C. S. Anderson*

AGR. ED. 525v. MASTER'S THESIS (1-6) Conferences and assignments in preparation of a thesis for the degree of Master of Science in agricultural education.
Professor H. S. Brunner and Staff

AGR. ED. 530v. AGRICULTURAL COLLEGE TEACHING (3) Selection and organization of subject matter for specific courses, methods of learning, teaching devices, the technique of teaching, and the measurements of the results of teaching. Lecture 3 hours. *Professor H. S. Brunner and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. ED. 416v. RURAL EDUCATION (3) *Professor W. F. Hall*
AGR. ED. 417v, 417vX. RURAL EDUCATION SURVEY (2) *Professor H. S. Brunner*
AGR. ED. 418v, 418vX. SURVEY OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Professor H. S. Brunner*
AGR. ED. 420v, 420vX. ADVANCED VISUAL AND OTHER SENSORY AIDS IN TEACHING AGRICULTURE (1-6) *Professor D. R. McClay*
AGR. ED. 421v. OBJECTIVES IN RURAL EDUCATION (3) *Professor W. F. Hall*
AGR. ED. 422v, 422vX. SUPERVISION OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Professor D. R. McClay*
AGR. ED. 434v, 434vX. AGRICULTURAL DEVELOPMENTS (1-6) *Mr. G. Z. Stevens*

AGRICULTURAL ENGINEERING

PROFESSOR RALPH U. BLASINGAME, B.S.
Head of the Department

AGR. ENG. 500. ADVANCED ELECTRO-AGRICULTURE (2-4) Investigations in the application of electrical energy to processing, storing, and handling agricultural products. Seminar, written reports.

AGR. ENG. 501. ADVANCED FARM MACHINERY (2-4) Duty and maintenance cost of farm machinery. Seminar: written reports.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. ENG. 400. AGRICULTURAL ENGINEERING PROBLEMS AND SEMINAR (1-7)
AGR. ENG. 401a,b,c,dS. FARM MECHANICS FOR THE TEACHER OF VOCATIONAL AGRICULTURE (1½-6)
AGR. ENG. 402. FUNCTIONAL DESIGN OF FARM STRUCTURES (3)
AGR. ENG. 405. ADVANCED FARM ELECTRIFICATION (3)
AGR. ENG. 406. ADVANCED DAIRY ENGINEERING (3)

AGRONOMY

PROFESSOR HERBERT R. ALBRECHT, M.S., Ph.D.
Head of the Department

AGRO. 501. ADVANCED SOIL FERTILITY (4) Factors which determine soil fertility; special attention to the diagnoses of soil and plant problems through field ap-

praisal, laboratory analyses, and plant symptoms; the agronomic properties of manures, fertilizers, and soil amendments, the influence of practices upon yield and composition and probable nutritive value of the crops. Prerequisites: Agro. 431, Bot. 406. *Professor F. G. Merkle*

AGRO. 503. AGRONOMY SEMINAR (1) A weekly meeting where papers and discussions will be presented by students and staff members. Each student will present a paper on some phase of his major subject.

AGRO. 506. SOIL CHEMISTRY (4) Analyses of the important chemical and biochemical reactions occurring in soils, the conditions which control these reactions and their importance in soil genesis and plant growth; laboratory work of the more typical and significant analytical procedures; lectures and reviews of current literature, and practicum. Prerequisites: Agro. 419, Agr. Biochem. 417 or Chem. 20. *Professor J. E. Steckel*

AGRO. 507. SOIL PHYSICS (4) Physical properties of the soil; factors affecting them; their measurements, evaluation, and influence in the determination of soil productivity. Prerequisites: Agro. 419, Phys. 215, Agr. Biochem. 425.
Professor R. B. Alderfer

AGRO. 509. GENETICS OF CROP PLANTS (3) The inheritance in crop plants with particular reference to factor interaction, the genetic aspects of linkage and crossing-over, quantitative inheritance, and heterosis. Prerequisite: Bot. 423.
Professor H. L. Carnahan

AGRO. 510. THE APPLICATION OF CYTOGENETICS TO PLANT BREEDING (3) Cytogenetics, including chromosome structure and behavior, chromosome alterations, polyploidy, interspecific hybridization and their applications to plant breeding. Prerequisite: Bot. 505. *Professor H. L. Carnahan*

AGRO. 511. THE BREEDING OF FARM CROPS (3) The application of genetic principles to the improvement of crop plants. Prerequisite: Hort. 7.

AGRO. 512. FIELD PLOT TECHNIQUE (3) The design and analyses of field experiments. Prerequisites: Math. 8, Com. 90, or Agr. Ec. 505.
Professor H. R. Fortmann

AGRO. 516. HUMUS (2) The origin and chemical nature of soil organic matter, its importance in soil processes, and its decomposition. Prerequisites: Agro. 419, 431. *Professor A. C. Richer*

AGRO. 517. FARM CROPS ECOLOGY (2) The ecological factors influencing the distribution and production of field crops. Prerequisites: Math. 8 or Bot. 406, Com. 90. Lecture 2 hours. *Professor L. L. Huber*

AGRO. 520. SPECIAL SOILS PROBLEMS (1-6 per semester) Provides basic or practical training in the soils sciences by means of library, field, and laboratory assignments.

AGRO. 545. THE APPLICATION OF STATISTICS TO FIELD EXPERIMENTS (3) The use of advanced experimental designs and statistical techniques in the planning,

analyses, and interpretation of field experiments. Prerequisite: Agro. 512. Lecture 3 hours. *Professor H. R. Fortmann*

AGRO. 550. SPECIAL CROPS PROBLEMS (1-6 per semester) Provides basic or practical training in the crops sciences by means of library, field, and laboratory assignments.

AGRO. 582. SEMINAR IN BREEDING AND GENETICS OF FARM CROPS (1-8 per semester) Lecture 1 hour.

AGRO. 583S. LABORATORY METHODS IN FIELD CROPS (3) Prerequisite: Agro. 512.

AGRO. 591. THESIS RESEARCH (1-15 per semester) Thesis research in the various crops and soils sciences falling within the research program of the department.

In addition to these cources, the following may be taken for graduate credit under the restrictions in force:

AGRO. 402. THE NATURE OF SOIL MINERALS (3) *Professor C. D. Jeffries*
AGRO. 416. THE CLASSIFICATION AND MAPPING OF SOILS (4) *Professor H. W. Higbee*
AGRO. 419. SOIL PROPERTIES (5) *Professor F. G. Merkle*
AGRO. 422. SOIL CONSERVATION (3) *Professor R. B. Alderfer*
AGRO. 423. MEADOW AND PASTURE MANAGEMENT (3) *Professor J. B. Washko*
AGRO. 431. SOIL FERTILITY AND MANAGEMENT (3) *Professor F. G. Merkle*
AGRO. 444. FIELD PLOT TECHNIQUE (3) *Professor H. R. Fortmann*

ANIMAL HUSBANDRY

PROFESSOR FRANKLIN L. BENTLEY, M.S.
Head of the Department

A.H. 501. PEDIGREE STUDY (1-6) Research work in breed study history, and analytical study of breed pedigrees, and a complete survey of the herd, flock, or stud book. *Professor W. L. Henning*

A.H. 502. RESEARCH IN MEATS (1-6 per semester) Investigational work pertaining to methods of handling, cutting, and processing meat and meat products; temperatures and their effect on tenderness, rancidity, and length of storage; freezer storage of meat and meat products; curing; current problems of the meat industry. Prerequisite: A.H. 421. *Professor P. T. Ziegler*

A.H. 503. LIVESTOCK MANAGEMENT (3) The handling of purebred herds and flocks; the relation of the livestock breeders to the public and methods of developing purebred herds and flocks through careful breeding. *Professor F. L. Bentley and Staff*

A.H. 504. LIVESTOCK HEALTH PROBLEMS (3) Problems dealing with the regulations governing the movement of livestock with special reference to control

measures applicable to diseases and disease groups common to men and animals. Prerequisites: A.H. 5, 415.

A.H. 505. Advanced Animal Breeding (1-5) Special problems in animal genetics as applied to breeding and improvement of horses, cattle, sheep, and swine. Prerequisites: A.H. 22, Bot. 22. *Professor W. L. Henning*

A.H. 506. Research in Animal Husbandry (2-10 per semester) The prosecution of an assigned problem under the guidance of an instructor. Prerequisites: A.H. 415, 421; or 426.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

A.H. 415. Advanced Anatomy and Physiology (3)
A.H. 421. Advanced Meat Studies (3) *Professor P. T. Ziegler*
A.H. 423. Advanced Stock Judging (2) *Professor W. L. Henning*
A.H. 424. Animal Husbandry Survey (1) *Professor F. L. Bentley and Staff*
A.H. 426. Livestock Markets and Marketing (3)
Professors F. L. Bentley, W. L. Henning
A.H. 428. Advanced Animal Nutrition (3) *Professor F. L. Bentley and Staff*

ANIMAL NUTRITION

Professor Raymond W. Swift, M.S., Ph.D.
Head of the Department

An. Nutr. 500. Research in Animal Nutrition (Credit to be arranged) Participation in the research program of the Department of Animal Nutrition and independent investigation. The available facilities make it possible to accommodate only a small number of students.

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

An. Nutr. 401. Physiology of Nutrition (3) *Professor Alex Black*
An. Nutr. 402. Physiology of Nutrition (3) *Professor C. E. French*

ARCHITECTURAL ENGINEERING

Consult Professor Louis A. Richardson, M.S.

A.E. 502. Architectural Engineering (3-8) Advanced structural design in steel and reinforced concrete. Lectures and class criticism. Practicum and seminar.
Professor L. A. Richardson and Staff

A.E. 503. Architectural Engineering (4-8) Continuation of A.E. 502 in which problems of wind bracing in tall buildings, rigid frames, and heavy-framed construction are studied. Practicum and seminar. *Professor R. B. Fox*

A.E. 504. Architectural Engineering (4-8) Statically indeterminate stresses in steel and reinforced concrete buildings; area moment, slope deflection, and moment distribution methods. Recitation and seminar.
Professor L. A. Richardson and Staff

A.E. 505. Architectural Engineering (4-8) Continuation of A.E. 504. Recitation and seminar. *Professor L. A. Richardson*

A.E. 506. Architectural Engineering Research (1-15) The presentation of an assigned problem under the guidance of an instructor.
Professors L. A. Richardson, R. B. Fox

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

A.E. 404. Architectural Engineering (4) *Professor R. B. Fox*
A.E. 405. Architectural Engineering (4) *Professor L. A. Richardson*
A.E. 406. Architectural Engineering (4) *Professor R. B. Fox*
A.E. 407. Architectural Engineering (3) *Professor L. A. Richardson*
A.E. 410. Architectural Engineering (3) *Professor L. A. Richardson*
A.E. 411. Architectural Engineering (3) *Professor R. B. Fox*

ARCHITECTURE

Professor Milton S. Osborne, M.S.
Head of the Department

Arch. 501. Architectural Design (4-8) Problems in advanced planning and design, including study of group composition. Practicum and seminar.
Professor M. S. Osborne and Staff

Arch. 502. Architectural Research (2-12) The prosecution of assigned problems under the guidance of an instructor. *Professor M. S. Osborne and Staff*

Arch. 503. Architectural History Research (3-12) Original research in architectural history. Seminar and written reports. *Professor H. E. Dickson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Arch. 406. Advanced Architectural Design (7)
Professors M. S. Osborne, K. J. Heidrich, A. W. Hajjar, F. C. Salmon, P. F. Hallock

Arch. 407. Advanced Architectural Design (7)
Professors M. S. Osborne, K. J. Heidrich, A. W. Hajjar, F. C. Salmon, P. F. Hallock

Arch. 410. Advanced Architectural Design (2-12)
Professor M. S. Osborne and Staff

Arch. 421. Contemporary Architecture (3) *Professor P. F. Norton*

ART

PROFESSOR MILTON S. OSBORNE, M.S.
Head of the Department of Architecture

(See also courses in Art Education below.)

ART 500. ART RESEARCH (2-6) The prosecution of assigned problems under the guidance of an instructor. *Professor H. S. Galbraith*

ART 501. ITALIAN PAINTING (2-6) Investigations in the field of early Italian painting. Seminar, written reports. *Professor H. E. Dickson*

ART 502. MEDIEVAL SCULPTURE (2-6) Sculpture of Italy and France from the 9th to the 13th centuries. Seminar, written reports. *Professor H. E. Dickson*

ART 503. ART HISTORY RESEARCH (3-12) Original study in some phase of the history of art; investigation of approved subjects. Seminar, written reports, drawing. Prerequisite: a 3-credit 400 course in art history.
Professor H. E. Dickson and Staff

ART 504. SEMINAR: ART LITERATURE AND ICONOGRAPHY (2-6) Required for degree candidates majoring in art history. Introduction to principles of research in fine arts, designed to familiarize the student with fundamental tools of scholarship in history of art; problems of bibliography and material of iconography; frequent reports on assigned topics provide actual practice in original research. Prerequisite: a minimum of 12 credits in history of art. Conference.
Professor H. E. Dickson and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ART 400S. OIL PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9)
ART 403S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3)
Professor H. E. Dickson
ART 404S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3)
Professor H. E. Dickson
ART 410. WATER-COLOR PAINTING: LANDSCAPE, STILL-LIFE, AND FIGURE (3)
Professor A. W. Case
ART 490. LIFE DRAWING (3) *Professor A. W. Case*

ART EDUCATION

Consult PROFESSOR VIKTOR LOWENFELD

ART ED. 514. FUNCTIONAL RELATIONSHIPS IN CRAFTS (3) Relationships of material design and purpose in crafts discussed by means of outstanding products of different materials, periods, and cultures. Prerequisite: 6 credits in crafts or 3 in design and 3 in advanced crafts. Lecture 2 hours, practicum 2 hours.

ART ED. 534. CREATIVE ART ACTIVITY FOR THE HANDICAPPED (3) Specific methods for development of creative art activity with the physically, mentally, emotionally, and socially handicapped; adjustive effect upon them. Prerequisite: 6 credits in art education or 6 in special education. Lecture 3 hours.

Professor Viktor Lowenfeld

ART ED. 586. RESEARCH IN ART EDUCATION (3-9) Current experiments in art education; required of students working for a master's degree in art education.

Professor Viktor Lowenfeld

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ART ED. 402. METHODS OF TEACHING DRAWING IN THE GRADES (2-3)
Professor Sybil Emerson

ART ED. 404. METHODS OF GRAPHICS AND ILLUSTRATIONS (3)

ART ED. 414. ADVANCED CRAFTS FOR TEACHERS (3-6) *Professor Sybil Emerson*

ART ED. 434. ART APPRECIATION IN THE EDUCATIONAL PROGRAM (2-3)

ART ED. 434b, 434bX. ART IN THE ELEMENTARY SCHOOL (2-3)
Professor Viktor Lowenfeld

ART ED. 434c, 434cX. ART IN THE SECONDARY SCHOOL (2-3)
Professor Viktor Lowenfeld

ART ED. 434d. ART SUPERVISION (3) *Professor Viktor Lowenfeld*

ART ED. 486, 486X. CURRENT PROBLEMS IN ART EDUCATION (2-3)
Professor Viktor Lowenfeld

ART ED. 487. MURAL PAINTING IN SCHOOLS (3) *Professor Viktor Lowenfeld*

ART ED. 488. ADVANCED MURAL PAINTING IN SCHOOLS (3)
Professor Viktor Lowenfeld

BACTERIOLOGY

PROFESSOR ROBERT W. STONE, Ph.D.
Head of the Department

BACT. 504. DAIRY BACTERIOLOGY PROBLEMS (2-15) Research on the microorganisms of importance in dairy sanitation, milk production, and manufacture of dairy products. Prerequisite: 12 credits in bacteriology.

BACT. 505. PATHOGENIC BACTERIOLOGY AND IMMUNOLOGY (2-15) Problems on the morphological, cultural, and immunological characteristics of pathogenic bacteria. Prerequisite: 12 credits in bacteriology.

BACT. 506. RESEARCH (2-15) Research in bacteriology for students who are doing their major work in this subject for the master's or doctor's degree. Prerequisite: 12 credits in bacteriology.

BACT. 507. BACTERIOLOGICAL SEMINAR (1-6) Reports on current fields of research. Prerequisite: 12 credits in bacteriology. *Professor J. J. Reid*

BACT. 508. PHYSIOLOGY OF BACTERIA (2) Metabolic processes of bacteria as influenced by their environment; the mechanism of fermentation and respiration of microorganisms. Prerequisite: Bact. 412. Lecture 2 hours.

Professor J. J. Reid

BACT. 508a. LABORATORY IN PHYSIOLOGY OF BACTERIA (2) Laboratory work to accompany the lectures given in Bact. 508. Prerequisite: Bact. 412. Practicum 6 hours. *Professor J. J. Reid*

BACT. 509. FERMENTATION (2) The chemical action of microorganisms on their environment; theories of carbohydrate breakdown and the application of these theories to industrial and agricultural fermentations. Prerequisites: Bact. 1, 2, Chem. 31. Lecture 2 hours. *Professor R. W. Stone*

BACT. 510. METHODS AND ANALYSES IN BACTERIAL FERMENTATION (2) Laboratory procedures and problems in fermentation to accompany Bact. 509. Prerequisites: Bact. 1, 2, Chem. 31. Practicum 6 hours. *Professor J. C. Gaey*

BACT. 511. BACTERIOLOGICAL LITERATURE (2-4) Assigned reading and conferences dealing with a student's research problem. May be taken only in those instances where a student is not scheduling Bact. 504, 505, or 506. Discussion and written reports. Prerequisite: 12 credits in bacteriology.

BACT. 512. LABORATORY IN ADVANCED BACTERIOLOGICAL TECHNIQUES (2-6) Certain techniques used in research including work with single cell isolation, Warburg apparatus, tissue culture and serology. May be repeated with credit. Prerequisite: 12 credits of bacteriology. Practicum 3 hours per credit.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

BACT. 407. BACTERIOLOGY PROBLEMS (2-9)
BACT. 410. IMMUNOLOGY AND SEROLOGY (4)
BACT. 411. BACTERIOLOGICAL SURVEY (1)
BACT. 412. ADVANCED BACTERIOLOGY (4)
BACT. 413. SOIL BACTERIOLOGY (4)
BACT. 414. FOOD BACTERIOLOGY (4)
BACT. 415. VIROLOGY (4)

BOTANY

PROFESSOR FRANK D. KERN, M.S., Ph.D., D.Sc.
Head of the Department

BOT. 501. THE PHYSIOLOGY OF THE FUNGI (3) The metabolism of the fungi, general and special nutrition, chemical composition, enzymes, spore germination, toxic and stimulating agencies, growth and tropism, etc. Prerequisites: Bot. 406, 419, and, preferably, Chem. 32. Lectures and practicum.

BOT. 502. THE ASCOMYCETES (3) The morphology, life histories, taxonomy, and physiology of the ascomycetous fungi. Prerequisite: Bot. 419. Lectures and practicum.

BOT. 503. THE RUSTS AND SMUTS (3) The morphology, life histories, taxonomy, and phylogeny of the rusts and smuts. Prerequisite: Bot. 419. Lectures and practicum. *Professor F. D. Kern*

BOT. 504. THE HIGHER BASIDIOMYCETES (3) The structures, habits, taxonomy, and relationships of the various groups of higher basidiomycetes. Prerequisite: Bot. 419. Lectures and practicum.

BOT. 505. CYTOLOGY AND CYTOGENETICS (3) Components of the protoplast, chromosome structure and cell division; meiosis and syngamy in the life cycle; alternation of chromosome phases in organisms; heteroploidy and chromosome aberrations such as chromosome fragments, inversions, deletions, duplications, transpositions, and translocations and their genetic implications. The role of chromosomes in heredity and breeding. Prerequisites: Bot. 22 or 32, 421.

BOT. 506. COMPARATIVE ANATOMY OF VASCULAR PLANTS (3) The special anatomical features of pteridophytes, gymnosperms, and angiosperms. Prerequisites: Bot. 7, 415, 416. Lectures and practicum. *Professor D. A. Kribs*

BOT. 507. VARIATION AND SELECTION (3) Variation and the results of selection in pure lines and clones involving the collection, interpretation, and analysis of data by biometrical means. Prerequisites: Bot. 22 or 32, 423. Lectures and practicum. *Professor J. P. Kelly*

BOT. 508. PROBLEMS OF HEREDITY (2-6) Problems in genetics selected to suit the needs and accomplishments of individual students. Prerequisites: Bot. 22 or 32, 422 or 423. *Professor J. P. Kelly*

BOT. 509. THE PHYSIOLOGY OF PARASITISM (3) The conditions and processes of infection, diseases, and death in plants as caused by parasitic organisms. Prerequisite: Bot. 10, 11, or 419. Lectures and practicum.
Professor H. W. Thurston

BOT. 510. PLANT PATHOLOGICAL PROBLEMS (3-6) Special diseases or disease groups, such as bacterial or mosaic diseases, etc. Prerequisite: Bot. 10 or 11. Conferences and practicum. *Professor H. W. Thurston*

BOT. 511. GROWTH AND MOVEMENT (2-4) The physiology of growth with special reference to the influence of external and internal factors upon growth, development, and movement of plants. Prerequisite: Bot. 406. Lecture 2 hours, practicum 4 hours. *Professor H. W. Popp*

BOT. 512. PLANT METABOLISM (2-4) The physiological processes involved in the metabolism of plants; alternates with Bot. 511. Prerequisite: Bot. 406. Lecture 2 hours, practicum 4 hours. *Professor H. W. Popp*

BOT. 514. CYTOTAXONOMY (2) Relationships within and between the groups of plants as indicated by their cytological features; the origin and relationships of

chromosome numbers, homoploidy and heteroploidy, hybridization, apomixis and related phenomena, and the role of these in geographic distribution and speciation in the plant kingdom. Prerequisites: Bot. 414, 505. Lecture 2 hours.

Professor H. A. Wahl

Bot. 515. Disease Resistance and Its Inheritance (2-4) The nature and etiology of plant diseases; disease resistance as a principle of control; ecology of plant diseases; concepts of disease resistance and escape; stability of disease resistance; economics of control; special problems. Prerequisites: Bot. 22 or 32, 10. Lecture 2 hours, practicum 3 to 6 hours. *Professors C. C. Wernham, W. R. Mills*

Bot. 517. The Fungi Imperfecti (3) The morphology, life histories, and taxonomy of the fungi imperfecti. Prerequisite: Bot. 419. Lectures and practicum.

Bot. 518. Botanical Research (1-15 per semester) The prosecution of an assigned problem under the guidance of an instructor.

Professor F. D. Kern and Staff

Bot. 527aS, 527bS. Foundations of Plant Biology (3 per course) Cellular structure and organization with consideration of the physiological and reproductive processes in so far as these form the basis of plant life. Bot. 527a and 527b will be offered in alternate years. In the former emphasis will be on cellular structure and physiology, in the latter on racial preservation and development and relationship of plant groups. Prerequisite: general biology or general botany courses.

Professor F. D. Kern

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Bot. 406. Plant Physiology (4) *Professor H. W. Popp*
Bor. 407. Plant Anatomy (3) *Professor D. A. Kribs*
Bot. 408. General Plant Pathology (3) *Professor H. W. Thurston*
Bot. 409S. Plant Ecology (3)
Bot. 412. Advanced Forest Pathology (3)
Bot. 414aS. Systematic Botany (3) *Professor H. A. Wahl*
Bot. 414bS. Systematic Botany (3) *Professor H. A. Wahl*
Bot. 415. Morphology of the Algae (3) *Professor H. A. Wahl*
Bot. 416. Morphology of the Bryophytes and Pteridophytes (3) *Professor H. A. Wahl*
Bot. 418. Botanical Problems (1-6) *Professor F. D. Kern and Staff*
Bot. 419. Mycology (3)
Bot. 420. Morphology of the Seed Plants (3) *Professor A. R. Grove*
Bot. 421. Botanical Technique (3) *Professor A. R. Grove*
Bot. 422. Genetic Phenomena (3)
Bot. 423. Advanced Genetics (2-6) *Professor J. P. Kelly*
Bot. 424. Commercial Tropical Woods (3) *Professor D. A. Kribs*
Bot. 425. Structure of Economic Plants (3)
Bot. 432S. Genetics, Eugenics, and Evolution (3)

CERAMICS

PROFESSOR EDWARD C. HENRY, M.S., Cer.E., Ph.D.
Chief of the Division

CER. 500. CERAMICS SEMINAR (1 per semester) Conferences, reading, and reports. Required of all graduate students in ceramics. Prerequisites: Chem. 41, Phys. 285. Lecture 1 hour. *Professor E. C. Henry and Staff*

CER. 501. CERAMICS RESEARCH (1-15 per semester) Laboratory study on special ceramic problems. Practicum 3 to 45 hours. *Professor E. C. Henry and Staff*

CER. 502. HEAT TREATMENT OF CERAMIC MATERIALS (2-5) Effect of controlled heat treatment on physical and chemical properties of various mineral systems.

CER. 503. CONSTITUTION OF GLASS (2-4) An advanced course on glass dealing with the latest developments in the structure of viscous liquids and transparent amorphous solids. Prerequisite: Cer. 415. Lecture 2 hours. *Professor Woldemar Weyl*

CER. 504. RESEARCH INSTRUMENTS AND EQUIPMENT (2) Application of fundamental laws and principles in research instruments; care, adjustment, and effective use of instruments and equipment (demonstrations). Prerequisite: Cer. 411. Lecture 2 hours.

CER. 505. GLASS TECHNOLOGY RESEARCH (1-15 per semester) Laboratory studies on special problems concerning the properties, constitution, and manufacture of glass. Prerequisite: Cer. 415. Practicum 3 to 45 hours.
Professor Woldemar Weyl and Staff

CER. 506. GLASS TECHNOLOGY SEMINAR (1-6) Group discussion of special advanced topics concerning the properties and manufacture of glass. Prerequisite: Cer. 415. Lecture 1 to 6 hours.

CER. 507. COLORING AND DECOLORIZING GLASS (1) Physical-chemical considerations of the various coloring oxides; oxidation-reduction equilibria pertaining to coloring and decolorizing of glass. Prerequisite: Cer. 415. Lecture 1 hour.
Professor Woldemar Weyl

CER. 508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2-3) Colloidal activity in bodies, glazes, and enamels, drilling fluids, filtering and bleaching clays, and similar mineral systems. (In co-operation with the Petroleum and Natural Gas staff.) Prerequisite: Chem. 41. Lecture 1 hour, recitation 1 or 2 hours. *Professor E. C. Henry*

CER. 509. SILICATE SYSTEMS (3) The properties of silica; classification of silicates; reactions in binary and ternary systems; industrial applications of the phase rule. Prerequisites: Chem. 41, Cer. 303. Lecture 3 hours. *Professor F. R. Matson*

CER. 510. CERAMIC PROBLEMS (1-6 per semester) Advanced individual study on a problem in some branch of ceramics, including review of the literature and a full report. Prerequisite: Cer. 411. Practicum 3 to 18 hours.
Professor E. C. Henry and Staff

CER. 511. SELECTED TOPICS IN CERAMICS (1-3 per semester) Intensive group study of special subjects, such as diffusion in solids, viscosity, and kinetics of ceramic processes. Prerequisites: Chem. 41, Phys. 285. Recitation 1 to 3 hours.
Professor E. C. Henry and Staff

CER. 512. SYNTHESIS OF CERAMIC COMPOUNDS (3) Advanced ceramic technology applied to the control of phases formed in commercial production of glass, whitewares, refractories, and cements. Prerequisites: Chem. 41, Cer. 303. Lecture 2 hours, practicum 3 hours. *Professor F. A. Hummel*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CER. 400. SPECIAL TOPICS (1-2)
CER. 401. CERAMIC BODIES AND GLAZES (3) *Professor F. A. Hummel*
CER. 402. PRINCIPLES OF CERAMIC ENGINEERING (3) *Professor E. C. Henry*
CER. 403. CERAMIC ENGINEERING PROCESSES AND EQUIPMENT (3)
Professor R. G. Ehman
CER. 404. CERAMICS SEMINAR (1) *Professor E. C. Henry and Staff*
CER. 405. CERAMIC RESEARCH AND DESIGN (3) *Professor E. C. Henry and Staff*
CER. 411. THEORY OF CERAMIC PROCESSES (3) *Mr. N. R. Thielke*
CER. 413, 413X. CERAMIC PETROGRAPHY (3) *Professor F. R. Matson*
CER. 415. GLASS AND ENAMELS (3) *Professor R. G. Ehman*
CER. 416. ADVANCED GLASS TECHNOLOGY (3)
Professor Woldemar Weyl, Dr. G. E. Rindone
CER. 420. REFRACTORIES (2) *Professor F. R. Matson*

CHEMICAL ENGINEERING

PROFESSOR DONALD S. CRYDER, M.S., D.Sc.
Head of the Department

CHEM. ENG. 500. SEMINAR IN CHEMICAL ENGINEERING (1) Required of all graduate students.

CHEM. ENG. 510. ADVANCED HEAT TRANSFER I (3) The physical and chemical factors controlling the rate of heat transfer under conditions of steady flow. Lecture 3 hours. *Professor D. S. Cryder*

CHEM. ENG. 511. ADVANCED HEAT TRANSFER II (3) Flow of heat under varying temperature conditions. Lecture 3 hours. *Professor D. S. Cryder*

CHEM. ENG. 513. DIFFUSION (2) The factors controlling diffusional operations such as absorption, extraction, humidification, etc. Lecture 2 hours.
Professor F. L. Carnahan

CHEM. ENG. 515. DISTILLATION (3) Commercial distillation, equilibrium diagrams, vapor composition, stills and rectifying and stripping columns. Lecture 3 hours. *Professor F. L. Carnahan*

CHEM. ENG. 516. ECONOMIC BALANCE (3) Problem work on the design of chemical engineering equipment from the economic standpoint. Lecture 3 hours.
Professor M. R. Cannon

CHEM. ENG. 518. CHEMICAL ENGINEERING DESIGN (3) Complicated examples are discussed and worked out. Several different unit operations will be combined for the design of a complete installation. Lecture 3 hours. *Professor D. S. Cryder*

CHEM. ENG. 519. CHEMISTRY OF COMBUSTION (3) The physical and chemical characteristics of combustion and their influence on plant scale equipment. Lecture 3 hours. *Professor D. S. Cryder*

CHEM. ENG. 524. CHEMICAL ENGINEERING, APPLICATION OF THERMODYNAMICS (3) Elements of thermochemistry and thermodynamics of greatest importance in chemical engineering. Lecture 3 hours. *Professor M. R. Cannon*

*CHEM. ENG. 580. RESEARCH IN PETROLEUM REFINING (3-15) Charge will be made for supplies consumed and breakage of equipment.
Professors M. R. Fenske, F. L. Carnahan, Dorothy Quiggle

†CHEM. ENG. 599. RESEARCH IN CHEMICAL ENGINEERING (1-15) Charge will be made for supplies consumed and breakage of equipment.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CHEM. ENG. 402. CHEMICAL ENGINEERING (4) *Professor F. L. Carnahan*
CHEM. ENG. 403. CHEMICAL ENGINEERING (4) *Professor F. L. Carnahan*
CHEM. ENG. 421. PETROLEUM PRODUCTS (4) Breakage ticket $3.
Professors F. L. Carnahan, D. S. Cryder, M. R. Cannon
CHEM. ENG. 422. MOTOR FUELS (2) *Professor F. L. Carnahan*
CHEM. ENG. 423. LUBRICANTS (2) *Professor F. L. Carnahan*
CHEM. ENG. 425. STANDARD TESTS OF PETROLEUM AND ITS PRODUCTS (1) Breakage ticket $2. *Professors F. L. Carnahan, D. S. Cryder, M. R. Cannon*

CHEMISTRY

PROFESSOR W. CONARD FERNELIUS, M.A., Ph.D.
Head of the Department

CHEM. 500. SEMINAR IN INORGANIC, MICRO, AND HOUSEHOLD CHEMISTRY (1)

CHEM. 501. SEMINAR IN PHYSICAL CHEMISTRY (1)

CHEM. 502. SEMINAR IN ORGANIC CHEMISTRY (1)

CHEM. 515. INORGANIC CHEMISTRY (2) Adapted to the needs of those desiring a general treatment of inorganic chemistry at an advanced level. Lecture 2 hours.
Professor A. H. Holtzinger

* Credits to be arranged, 3 to 15 per semester.
† Credits to be arranged, 1 to 15 per semester.

CHEM. 525. THEORIES UNDERLYING ANALYTICAL CHEMISTRY (2) Lecture 2 hours.

CHEM. 531. SPECIAL TOPICS IN ORGANIC CHEMISTRY (3) May be taken for credit for four successive semesters. Lecture 3 hours.

CHEM. 531a. ORGANOMETALLIC CHEMISTRY (3) An intensive coverage of the chemistry of organometallic compounds and their use in organic syntheses. Lecture 3 hours. *Professor L. H. Sommer*

CHEM. 532. ORGANIC NITROGEN COMPOUNDS (3) The chemistry of the organic compounds containing nitrogen in its various states of combination; esters of oxyacids of nitrogen, amines, amides, iminoesters, hydroxylamines, hydroxamic acids, oxines, nitrosocompounds, diazo and azocompounds, pseudo-bases; stereochemistry of nitrogen, application of modern theories of molecular structure to the constitution of organic nitrogen compounds. Lecture 3 hours.
Professor J. G. Aston

CHEM. 533. TERPENES (3) The terpenes and their more important derivatives with special reference to the application of the principles of aliphatic chemistry. Lecture 3 hours.

CHEM. 534. THEORETICAL ORGANIC CHEMISTRY (3) Application of modern theories of atomic and molecular structure to organic chemistry; resonance in organic compounds; interpretation of physical properties and application to structure proof; theory of rates of chemical reactions as applied to organic chemistry—representative examples; equilibrium properties as a limiting consideration. Lecture 3 hours. *Professor J. G. Aston*

CHEM. 535. ORGANIC CHEMISTRY (3) Adapted to the needs of those doing research work in organic chemistry. Lecture 3 hours. *Professor H. D. Zook*

CHEM. 536. ORGANIC CHEMISTRY (3) Continuation of Chem. 535. Lecture 3 hours.
Professor H. D. Zook

CHEM. 538. ORGANIC CHEMISTRY (3) A survey of organic chemistry arranged primarily for graduate students majoring in fields other than organic chemistry. Lecture 3 hours. *Professor C. I. Noll*

CHEM. 539. STEREOCHEMISTRY (3) A comprehensive treatment of the principles of stereochemistry as applied to organic compounds. Lecture 3 hours.
Professor T. S. Oakwood

CHEM. 541. PHASE RULE (3) The phase rule and its applications. Lecture 3 hours. Given 1950-51 and in alternate years thereafter. *Professor A. J. Currier*

CHEM. 542. COLLOIDS (3) The physics and chemistry of surfaces and their resulting colloid properties. Methods of preparing colloids. Lecture 3 hours.

CHEM. 543. RHEOLOGY OF COLLOIDS (3) Continuation of Chem. 542. Rheology, especially as applied to colloids and similar substances. Lecture 3 hours.

CHEM. 544. CHEMICAL THERMODYNAMICS (3) Development of thermodynamic theory with special reference to common physical changes and chemical reactions.

Prerequisite: Chem. 441 or 562. Lecture 3 hours. *Professor J. G. Aston*

CHEM. 545. CHEMICAL THERMODYNAMICS AND INTRODUCTORY STATISTICAL MECHANICS (3) Continuation of Chem. 544 including the calculation of thermodynamic properties from molecular and spectroscopic data. Prerequisite: Chem. 544. Lecture 3 hours. *Professor J. G. Aston*

CHEM. 546. QUANTUM CHEMISTRY (3) Theory of energy levels in atoms and molecules from the standpoint of wave mechanics with specific emphasis on the portion of the subject applying to common chemical systems. Prerequisite: Chem. 441 or 562. Lecture 3 hours. Given alternate years only. *Professor J. G. Aston*

CHEM. 547. STATISTICAL MECHANICS (3) The properties of matter at equilibrium developed on the basis of the energy levels of molecules and statistical mechanical theory; calculation of heat capacity, entropy and free energy of gases, crystals, etc. Prerequisite: Chem. 546. Lecture 3 hours. Given alternate years only. *Professor J. G. Aston*

CHEM. 548. CATALYSIS (3) The theory of catalysis and its application to industry. Lecture 3 hours. Given 1951-52 and in alternate years thereafter. *Professor A. J. Currier*

*CHEM. 550. RESEARCH IN HOUSEHOLD CHEMISTRY (1-15) Charge will be made for supplies consumed and breakage of equipment. *Professor P. B. Mack*

CHEM. 561. CHEMICAL PRINCIPLES (3) A mathematical treatment of the classical principles of chemistry; their application to problems. Required of all graduate students. Prerequisites: Chem. 41, Math. 11, Phys. 285. A course in organic chemistry is recommended. Lecture 3 hours. *Professors J. G. Aston, A. W. Hutchison*

CHEM. 562. CHEMICAL PRINCIPLES (3) Continuation of Chem. 561. Required of all graduate students. Lecture 3 hours. *Professors J. G. Aston, A. W. Hutchison*

CHEM. 563. CHEMICAL KINETICS (3) The theory and measurement of the rates of chemical reactions; the mechanism of chemical reactions. Lecture 3 hours. *Professor J. H. Simons*

CHEM. 564. CHEMICAL KINETICS (3) Continuation of Chem. 563 but including the theory and measurement of photochemical reactions. Lecture 3 hours. *Professor J. H. Simons*

CHEM. 565. ATOMIC AND MOLECULAR STRUCTURE (3) The structure of chemical species and the correlation of experimentally determined properties by structural theory. Lecture 3 hours. *Professor J. H. Simons*

CHEM. 566. ATOMIC AND MOLECULAR STRUCTURE (3) Continuation of Chem. 565. Lecture 3 hours. *Professor J. H. Simons*

CHEM. 567. ADVANCED THEORETICAL CHEMISTRY (3) Modern and current theories of the properties of chemical substances and their applications to chemical problems; the construction of chemical theory. Lecture 3 hours. *Professor J. H. Simons*

* Credits to be arranged, 1-15 per semester.

CHEM. 568. ADVANCED THEORETICAL CHEMISTRY (3) Continuation of Chem. 567. Lecture 3 hours. *Professor J. H. Simons*

*CHEM. 580. RESEARCH IN PETROLEUM REFINING (1-15) Charge will be made for supplies consumed and breakage of equipment. *Professor M. R. Fenske*

*CHEM. 599. RESEARCH IN CHEMISTRY (1-15) Charge will be made for supplies consumed and breakage of equipment.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CHEM. 400. CHEMICAL LITERATURE (1) *Miss M. L. Jackson*
CHEM. 411. FLUORINE CHEMISTRY (3) *Professor J. H. Simons*
CHEM. 412. FLUORINE CHEMISTRY (3) *Professor J. H. Simons*
CHEM. 426. ADVANCED QUALITATIVE AND QUANTITATIVE ANALYSIS (5) Breakage ticket $10.
CHEM. 434. QUANTITATIVE ORGANIC ANALYSIS (3-5) Breakage ticket $10 for 3 credits, $12 for 4 or 5 credits. *Professor R. W. Higgins*
CHEM. 435. ORGANIC PREPARATIONS AND LABORATORY METHODS (3-5) Breakage ticket $10 for 3 credits, $12 for 4 or 5 credits. *Professor R. W. Higgins*
CHEM. 436. ORGANIC CHEMISTRY OF NATURAL PRODUCTS (3) *Professor J. G. Aston*
CHEM. 437. QUALITATIVE ORGANIC ANALYSIS (3) Breakage ticket $4. *Professor J. H. Olewine*
CHEM. 438. INTRODUCTION TO RESEARCH IN ORGANIC CHEMISTRY (2-5) Breakage ticket $10 for 2 or 3 credits, $12 for 4 or 5 credits. *Professor R. W. Higgins*
CHEM. 440. ADVANCED PHYSICAL CHEMISTRY (3) *Professors A. W. Hutchison, R. P. Seward*
CHEM. 441. ADVANCED PHYSICAL CHEMISTRY (3) *Professors A. W. Hutchison, R. P. Seward*
CHEM. 448. COLLOID CHEMISTRY (3) Breakage ticket $3. *Professor A. W. Hutchison*
CHEM. 453a-h. RECENT ADVANCES IN TEXTILE CHEMISTRY (1-8)
CHEM. 470. CHEMICAL MICROSCOPY (3) Breakage ticket $2. *Professor M. L. Willard*
CHEM. 471. ADVANCED CHEMICAL MICROSCOPY (3) Breakage ticket $2. *Professor M. L. Willard*
CHEM. 472. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket $2. *Professor G. H. Fleming*
CHEM. 473. TEXTILE MICROSCOPY (3) Breakage ticket $2. *Professor M. L. Willard*
CHEM. 474. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket $2. *Professor G. H. Fleming*
CHEM. 475. INTRODUCTION TO CHEMICAL SPECTROSCOPY (3) Breakage ticket $2.
CHEM. 476. MICROSCOPIC MICROTECHNIQUE (3) Breakage ticket $2. *Professor M. L. Willard*
CHEM. 477. PAPER MICROSCOPY (3) Breakage ticket $2. *Professor M. L. Willard*

* Credits to be arranged, 1-15 per semester.

†CHEM. 490. ORGANIC CHEMISTRY (5) Breakage ticket $4.
Professor J. H. Olewine

†CHEM. 491. ORGANIC CHEMISTRY (5) Breakage ticket $12.
Professor J. H. Olewine

†CHEM. 492a. ADVANCED GENERAL CHEMISTRY (3) Breakage ticket $3.
Professor A. J. Currier

†CHEM. 492b. ADVANCED GENERAL CHEMISTRY (3) Breakage ticket $3.
Professor A. J. Currier

†CHEM. 495. EXPERIMENTAL PROBLEMS IN CHEMISTRY (3 or 6) Breakage ticket $10 for 3 credits, $12 for 6 credits.
Professor A. J. Currier

†CHEM. 496. GENERAL PHYSICAL CHEMISTRY (3) *Professor A. W. Hutchison*

†CHEM. 497. GENERAL PHYSICAL CHEMISTRY (2) *Professor A. W. Hutchison*

†CHEM. 498. PHYSICOCHEMICAL MEASUREMENTS (1) Breakage ticket $6.
Professor A. W. Hutchison

†CHEM. 499. PHYSICOCHEMICAL MEASUREMENTS (1) Breakage ticket $6.
Professor A. W. Hutchison

CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS

PROFESSOR WINONA M. MORGAN, M.A., Ph.D.
Head of the Department

CH. FAM. 508. PARENTAL EDUCATION (3) Discussion and use of methods, experiences, and programs which can be used effectively to help parents in dealing with problems of parent-child relationships. Prerequisites: Ch. Fam. 429, 430. Lecture 3 hours. *Professor W. L. Morgan*

CH. FAM. 515, 515X. THE TEACHING OF CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (3) Methods of selection and presentation of subject matter basic to understanding the development of children, and the attitudes, emotions, and relationships within the family. Not open to students having credit for Ch. Fam. 432. Prerequisite: 6 credits in child development and family relationships.
Professor W. L. Morgan

CH. FAM. 536. CHILDREN IN POSTWAR FAMILIES AND COMMUNITIES (3) Postwar family and community situations influencing the development of children; the role of parents and teachers in helping individual children make satisfactory adjustments. Prerequisites: Ch. Fam. 429, 430, or 2 courses in psychology. Lecture 3 hours. *Professor W. L. Morgan*

CH. FAM. 540. SEMINAR IN CHILD DEVELOPMENT (1-6) Readings and reports on recent findings in child development. Prerequisites: Ch. Fam. 429, 430, or Psy. 411 or 425. Lecture hours to be arranged. *Professor W. L. Morgan*

CH. FAM. 545, 545X. THE FAMILY IN ITS COMMUNITY (2-3) Cultural influences on family relationships; how the family orients its members to community living

† Candidates for the M.Ed. degree.

and group participation. Prerequisites: Soc. 1, Ch. Fam. 405; Rur. Soc. 452 or Psy. 419. Lecture and recitation 2 or 3 hours. *Professor W. M. Smith, Jr.*

CH. FAM. 546. SEMINAR IN FAMILY RELATIONSHIPS (1-3) Reading, reports, and discussion of recent research in relationship aspects of family living; particular attention to studies of roles, crises, and adjustments within the family setting. Prerequisite: Ch. Fam. 405 or 6 hours of sociology or psychology. Lecture and recitation 1 to 3 hours. *Professor W. M. Smith, Jr.*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CH. FAM. 405. MARRIAGE AND FAMILY RELATIONSHIPS (3) *Professor M. S. McDowell*

CH. FAM. 429, 429X. CHILD DEVELOPMENT (3) *Professor D. J. Avery*

CH. FAM. 430. OBSERVATION AND EXPERIENCE IN NURSERY SCHOOL (1-5)

CH. FAM. 440, 440X. STUDY OF LATER CHILDHOOD (3) *Professor D. J. Avery*

CH. FAM. 441. NURSERY SCHOOL ORGANIZATION (3)

CH. FAM. 481. EDUCATIONAL METHODS WITH PRESCHOOL CHILDREN (3)

CH. FAM. 482. EDUCATIONAL PROCEDURES IN CHILD DEVELOPMENT AND FAMILY RELATIONS (3)

CIVIL ENGINEERING

PROFESSOR BENJAMIN A. WHISLER, M.S., SC.D.
Head of the Department

C.E. 500. SEMINAR IN CIVIL ENGINEERING (1-6) Reports on researches and special topics. Course may be continued in subsequent semesters.

C.E. 521. TRANSPORT PLANNING AND DESIGN (2-6) Planning and design of transportation facilities; basic principles and engineering techniques applied to airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

C.E. 522. TRANSPORT OPERATION AND MAINTENANCE (2-6) Engineering problems in the operation, maintenance, and administration of airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

C.E. 540. ADVANCED STRUCTURAL ANALYSIS (2-4) Geometry of flexure; deflections; analysis of continuous beams, rigid frames, arches; influence lines. Prerequisite: C.E. 40. Lecture 3 hours.

C.E. 541. ADVANCED STRUCTURAL ANALYSIS (2-4) Truss deflection; trusses with redundant members, continuous trusses, framed arches; influence lines; secondary stresses; wind stresses; space framework; suspension bridges. Prerequisite: C.E. 40.

C.E. 542. APPLIED SOIL MECHANICS (2-5) Soil classification by type of clay minerals and profile development; aerial photographic interpretation of soils and applications to site selection for dams, highways, and airports. Prerequisites: C.E. 412, 444, Geol. 71.

C.E. 543. Structural Engineering Projects (3-10) Investigation or design projects in concrete, soil mechanics, photoelasticity, analysis, etc. Prerequisite or concurrent: C.E. 441, 442.

C.E. 544. Advanced Structural Design (2-4) Plain and reinforced concrete design as applied to buildings, bridges, retaining walls, domes, tanks, and dams; prestressed concrete. Prerequisite: C.E. 42, 442.

C.E. 545. Advanced Structural Design (2-4) Structural steel design as applied to riveted and welded girders, trusses, rigid frames, wind connections; timber design. Prerequisite: C.E. 41. Lecture 3 hours.

C.E. 546. Structural Data as Basis for Design Specifications (2) Critical study of experimental data and design specifications for steel and reinforced concrete. Prerequisites: C.E. 41, 42. Lecture 2 hours.

C.E. 550. Engineering Construction (2-4) Construction methods applied to foundations, buildings, bridges, and other civil engineering construction work. Prerequisites: C.E. 41, 42.

C.E. 551. Hydrologic Investigations (2-8) Application of hydrologic principles and techniques to a specific project. Prerequisite: C.E. 451.

C.E. 560. Hydraulic Structures (3) Hydraulic and structural considerations in the design of dams, spillways, gates, canals and flumes, siphons, and locks. Prerequisite: C.E. 462.

C.E. 562. Fluid Dynamics (3) Eulerian equations, potential theory, conformal mapping, two- and three-dimensional flow of fluids, boundary layers, turbulence, compressibility, surface wave effects. Prerequisites: Math. 100 or 431, C.E. 462.

C.E. 563. Hydraulics Research (2-8) Analytical or experimental study of a problem in hydraulics. Prerequisite: C.E. 462.

C.E. 564. Hydraulic Engineering Design (2-8) Design and analysis of selected units of a typical hydraulic engineering project. Prerequisite: C.E. 462.

C.E. 566. Hydraulic Machinery (3) Theory and applications of impulse and reaction turbines, centrifugal and axial flow pumps, fluid couplings and torque converters, hydraulic controls. Prerequisite: C.E. 462. Lecture 3 hours.

C.E. 567. Resistance and Propulsion (3) Free surface and shallow water effects, planing surfaces, model testing, propellor systems, effects of wake and cavitation on propellors. Prerequisite: C.E. 562. Lecture 3 hours.

C.E. 568. Theoretical Hydrodynamics (3) Analysis of the irrotational motion of fluids in two and three dimensions, vortex motion, wave theory, theory of viscous fluids. Prerequisite: C.E. 562. Lecture 3 hours.

C.E. 569. Research in Fluid Dynamics (1-8) Analytical or experimental study of a problem in fluid dynamics. Prerequisite: C.E. 562.

C.E. 571. Water Purification and Softening (2-6) The principal methods of

softening and purifying water for potable and commercial purposes. Prerequisite: C.E. 471.

C.E. 572. Sewage Disposal (2-6) Methods of disposal of sewage by dilution, tank treatment, oxidation processes, etc. Prerequisite: C.E. 472.

C.E. 573. Sanitary Engineering Projects (3-10) Investigation of problems in water, sewage, and wastes treatment. Prerequisite: C.E. 472.

C.E. 575. Industrial Waste Treatment and Disposal (2-5) Sanitary analyses and characteristics of industrial wastes; stream pollution and the factors involved in the self-purification of streams. Prerequisite: C.E. 472. Lecture 2 hours minimum, practicum 3 hours minimum.

C.E. 576. Water Treatment Plant Design (3-6) Design of works connected with the treatment of water for potable, commercial, and industrial purposes. Prerequisite: C.E. 70. Lecture 2 hours minimum, practicum 3 hours minimum.

C.E. 577. Sewage Treatment Plant Design (3-6) Design of work connected with the treatment and disposal of sewage and/or trade wastes. Prerequisite: C.E. 71. Lecture 2 hours minimum, practicum 3 hours minimum.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

C.E. 401a,b,c,d. Civil Engineering Projects (2-12)
C.E. 412. Advanced Photogrammetry (3)
C.E. 421. Highways and Streets (3)
C.E. 422. Railroads (3)
C.E. 431. Civil Engineering Construction (3)
C.E. 441. Statically Indeterminate Structures (3)
C.E. 442. Statically Indeterminate Structures (3)
C.E. 443. Photoelasticity and Model Analysis (3)
C.E. 444. Soil Mechanics and Foundations (3)
C.E. 446. Advanced Soil Mechanics (3)
C.E. 451. Advanced Hydrology (3)
C.E. 462. Advanced Hydraulics (3)
C.E. 463. Hydraulic Laboratory Investigations (1-6)
C.E. 471. Municipal and Rural Sanitation (3)
C.E. 472. Sewage and Industrial Wastes Treatment (3)
C.E. 473. Sanitary Engineering Problems (4)
C.E. 474. Advanced Sanitary Engineering Problems (3)
C.E. 481. Municipal Planning and Zoning (3)
C.E. 482. Municipal Engineering and Management (3)

CLOTHING AND TEXTILES

Professor Ruth E. Graham, M.S.
Head of the Department

Cl. Tex. 502. Tailoring (3) The construction of tailored garments for women

and children from new or renovated materials. Prerequisites: Cl. Tex. 102, 201. Lecture 1 hour, practicum 5 hours. *Professor M. E. Westgate*

Cl. Tex. 503. Advanced Fitting and Pattern Study (3) Application of the principles involved in altering patterns and fitting garments to give students freedom in designing and ability to deal with difficult fitting problems. Prerequisite: Cl. Tex. 201. Lecture 1 hour, practicum 5 hours.
Professor M. E. Westgate

Cl. Tex. 504. Advanced Dress Design (3) Draping of garments difficult in type and distinctive in design; survey of literature in dress design. Prerequisites: Art 56, Cl. Tex. 404. Conference 1 hour, practicum 5 hours.

Cl. Tex. 505, 505X. Clothing Instructional Materials (3) Preparation and evaluation of different types of materials for instruction in textiles and clothing. Prerequisite: Cl. Tex. 201. Lecture 1 hour, practicum 5 hours.

Cl. Tex. 506. The Fashion World (3) The development of fashion throughout the ages; relationship of present-day fashions and practices to previous periods. Prerequisites: Cl. Tex. 102, 301. Lecture 3 hours. *Professor R. E. Graham*

Cl. Tex. 507. Problems in Relation to Clothing Consumption (3) Problems connected with the manufacture and consumption of clothing, interrelation of the textile and clothing trades with other industries. Prerequisite: Cl. Tex. 301. Lecture 3 hours. *Professor R. E. Graham*

Cl. Tex. 508. Special Problems in Clothing and Textiles (1-6) Individual directed study, investigation, and practice in selected phases of textiles and clothing. Prerequisites: Cl. Tex. 102, 201. Lecture hours to be arranged.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Cl. Tex. 401. Clothing Conservation (2-3)
Cl. Tex. 403. Fitting and Pattern Adjustment (3) *Professor M. E. Westgate*
Cl. Tex. 404. Dress Design (3)
Cl. Tex. 405S. Fashion Merchandising (3)
Cl. Tex. 406. Fashion Promotion of Textiles and Clothing (3)
Cl. Tex. 407. The Textile and Clothing Industry (3)

COMMERCE

Professor William N. Leonard, A.M., Ph.D.
Head of the Department of Economics

Com. 500. Case Studies in Business Administration (3) Case studies of business and management policy with respect to procurement, production, selling, finance, accounting, relations with government, labor, and the public. Prerequisite: Com. 401. Lecture 3 hours.

Com. 505. Problems of Corporation Finance (3) The more important current

problems of corporate financial policy, particularly problems of promotion, capitalization, security issue, valuation, administration of income, expansion, reorganization, and government control of policy. Prerequisites: Com. 5, 41. Lecture 3 hours. *Professor G. L. Leffler*

Com. 510. Interbank Relations (3) Local clearings, out-of-town collections, correspondent banking, branch and group banking, Federal Reserve relations with member and nonmember banks. Prerequisite: Com. 410. Lecture 3 hours. *Professor D. H. McKinley*

Com. 515. Transportation Rates and Business (3) Rate making and rate changes and their effects on business location and development. Prerequisite: Com. 15. Lecture 3 hours. *Professor R. H. Waters*

Com. 517. International Business Practices (3) Practices of exporters and importers dealing in commodities traded in world markets under competition, monopoly, or governmental control. Prerequisite: Com. 17. Lecture 3 hours. *Professor W. M. Hench*

Com. 524. Marketing Policies (3) Major problems of sales planning, organization, control, and supervision; current trends in merchandising policies of manufacturers; selection and training of salesmen, preparation of selling methods, sales budgets and sales quotas. Prerequisite: Com. 424. Lecture 3 hours. *Professor J. R. Hilgert*

Com. 525. Case Studies in Insurance (3) An analysis of management's insurance problems, such as the feasibility of self-insurance; proper allocation of insurance premiums and coverage in selected industries, etc. Prerequisite: Com. 25; 33 or 34. Lecture 3 hours. *Professor R. H. Wherry*

Com. 530. C.P.A. Law Review (3) Business law affecting accounting; impact of state and federal laws affecting accounting and business practice; review of current legislation. Prerequisite: Com. 430. Lecture 3 hours. *Professor S. C. Tanner*

Com. 536. Problems in Sales Management (3) Principles of sales planning and administration; co-ordination of selling with advertising, promotion, production, and accounting; use of market research selling costs and budgets. Prerequisites: Com. 36, Econ. 1. Lecture 3 hours.

Com. 548. Accounting Systems (3) Principles of system design including practical application to special businesses, such as financial institutions, department stores, public utilities, etc. Prerequisite: Com. 442. Lecture 3 hours. *Professor C. J. Rowland*

Com. 550. Real Estate Problems (3) Analysis of current real estate problems and practices for the broker, the business man, and the property owner; appraisal methods; property management; housing, and the legal, financial, economic, and social aspects of the real estate field. Prerequisite: Com. 50. Lecture 3 hours. *Mr. B. B. Lethbridge*

Com. 560. Problems of Business Location (3) The economic relationship of such factors as climate, resources, population, transportation and markets, and

the location of enterprise. Prerequisite: Com. 60. Lecture 3 hours.
Professor G. F. Mitch

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Com. 401.	Purchasing (3)	*Professor F. A. Babione*
Com. 402.	Controllership (3)	*Professor G. A. Tefft*
Com. 405.	Analysis of Financial Statements (3)	*Professor F. H. Cook*
Com. 410.	Bank Management (3)	*Professor D. H. McKinley*
Com. 415.	Regulation of Transport Carriers (3)	*Professor R. H. Waters*
Com. 417.	Foreign Markets (3)	*Professor W. M. Hench*
Com. 424.	Marketing Research (3)	*Professor J. R. Hilgert*
Com. 425.	Insurance Agency Management (3)	*Professor R. H. Wherry*
Com. 428.	Retail Advertising and Store Promotion (3)	*Professor F. A. Babione*
Com. 430.	Advanced Business Law (3)	*Professor S. C. Tanner*
Com. 442.	Advanced Accounting (3)	*Professor C. J. Rowland*
Com. 444.	Budgetary Control (3)	
Com. 448.	C.P.A. Review Course (3)	*Professor C. J. Rowland*
Com. 450.	Housing and Community Development (3)	*Mr. B. B. Lethbridge*
Com. 460.	American Industries (3)	*Professor G. F. Mitch*

COMMERCIAL CONSUMER SERVICES

Professor Mary Brown Allgood, M.S.
Chairman of the Division

The following courses may be taken for graduate credit under the restrictions in force:

C. Con. S. 403. Theories and Techniques for Commercial Demonstrators (2)
Professor M. B. Allgood

C. Con. S. 450. Problems in Household Equipment (1-6)
Professor M. B. Allgood

DAIRY HUSBANDRY

Professor Donald V. Josephson, M.S., Ph.D.
Head of the Department

D.H. 501. Butter and Cheese (1-6) The manufacture and handling of butter and cheese. Prerequisites: D.H. 10, 23, Bact. 8, Agr. Biochem. 403.
Professor C. D. Dahle

D.H. 502. Condensed Milk and Milk Powder (1-6) The condensing and drying of milk. Prerequisites: D.H. 10, 26, Bact. 8, Agr. Biochem. 403.
Professor F. J. Doan

D.H. 503. Public Milk Problems (1-6) The handling of milk in modern plants. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403. *Professor F. J. Doan*

D.H. 504. Ice Cream Manufacture (1-6) The manufacture of ice cream, ices, and other frozen milk products. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403. *Professor C. D. Dahle*

D.H. 505. Dairy Plant Economics (1-6) The economic factors involved in creamery operation and management. Prerequisites: D.H. 7, 11. *Professor C. D. Dahle*

D.H. 506. Dairy Cattle Breeding (1-6) The improvement of dairy cattle, including methods of sire evaluation, systems of breeding, and the development of breeding programs. Prerequisite: D.H. 30. *Professor J. O. Almquist*

D.H. 507. Dairy Cattle Management (1-6) The management of dairy cattle. Prerequisite: D.H. 27. *Professor A. L. Beam and Staff*

D.H. 508. Dairy Seminar (1-6) The preparation and presentation of a paper on an assigned subject. *Professor D. V. Josephson and Staff*

D.H. 509. Testing Dairy Products (1-6) The constituents of dairy products. Prerequisites: D.H. 10, 11, Bact. 8, Agr. Biochem. 403. *Professor W. D. Swope*

D.H. 510. Dairy Cattle Feeding (1-6) The application of fundamental research in animal nutrition to the feeding of dairy cattle. Prerequisites: D.H. 1, 29. *Professors A. L. Beam, P. S. Williams*

D.H. 511. Dairy Cattle Nutrition (1-6) The nutritional requirements of dairy cattle. Prerequisites: An. Nutr. 401, 402. *Professor C. B. Knodt and Staff*

D.H. 512. Advanced Studies in Milk Secretion (1-6) The physiology of milk secretion. Prerequisite: D.H. 427. *Professor C. B. Knodt*

D.H. 513. Dairy Cattle Selection (1-6) Breed history, pedigrees, selection and judging of dairy cattle. Prerequisites: D.H. 1, 30. *Professor C. B. Knodt and Staff*

D.H. 514. Advanced Reproductive and Endocrine Physiology (2-3) The physiology of reproduction and endocrine physiology of mammals. Prerequisites: A.H. 415, D.H. 431. Given in alternate years. *Professor J. O. Almquist*

D.H. 515. Advanced Physiology of Reproduction in Farm Animals (1-6) The reproduction of farm animals. Prerequisite: D.H. 514. *Professor J. O. Almquist*

D.H. 516. Artificial Breeding of Farm Animals (1-6) Prerequisite: D.H. 431. *Professor J. O. Almquist*

D.H. 517. Dairy Husbandry Literature (1-6) The review and reporting of dairy literature. *Professor D. V. Josephson and Staff*

D.H. 518. Thesis (1-15) *Professor D. V. Josephson and Staff*

D.H. 519. Research in Dairy Production (1-15 per semester)
Professor D. V. Josephson and Staff

D.H. 520. Research in Dairy Manufacturing (1-15 per semester)
Professor D. V. Josephson and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

D.H. 418. Dairy Survey (1) *Professor D. V. Josephson*
D.H. 421. Dairy Manufacturing Problems (1-6)
Professors C. D. Dahle, F. J. Doan, and Staff
D.H. 427. Milk Secretion (3) *Professor C. B. Knodt*
D.H. 428. Dairy Production Problems (1-3) *Professor A. L. Beam and Staff*
D.H. 429. Testing Dairy Products (1-6) *Professor W. D. Swope and Staff*
D.H. 430. Technical Control of Dairy Products (4) *Mr. G. H. Watrous, Jr.*
D.H. 431. Physiology of Reproduction in Farm Animals (3)
Professor J. O. Almquist

DRAMATICS

Consult Professor Arthur C. Cloetingh, M.A.

Dram. 501. Problems of Directing (3-6) Seminar in problems of production with particular stress on direction. Students will direct plays under staff supervision. *Professor R. D. Reifsneider*

Dram. 502. Seminar in the Technical Problems of Dramatic Production (3) Prerequisite: Dram. 11. *Professor A. C. Cloetingh*

Dram. 503. Art of Dramatic Lighting (3) Seminar in stage lighting; advanced study in the theory of lighting as used for dramatic effectiveness. Practical work required of each student. Prerequisite: Dram. 12. *Professor W. S. Smith*

Dram. 504. Seminar in Styles of Acting (3-6) Practical work required of each student. *Professor A. C. Cloetingh*

Dram. 506. Evaluation and Appreciation of Modern Dramatic Entertainment (3) Prerequisites: Dram. 1, 61. *Professor A. C. Cloetingh*

Dram. 507. Seminar in Fundamental Theories of Theater and Drama (3-6) Prerequisite: graduate standing. Recitation 3 hours. *Professor A. C. Cloetingh*

Dram. 521. Playwriting (3-6) Prerequisites: Dram. 21, 421. Recitation 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Dram. 403. Advanced Make-Up (1) *Professor W. S. Smith*
Dram. 411. Technical Production (3)
Dram. 412. Dramatic Design (3) *Professor Dorothy Scott*

DRAM. 413. ADVANCED STAGE LIGHTING (3)
DRAM. 421. ADVANCED PLAYWRITING (3) *Professor W. S. Smith*
DRAM. 431. HISTORY OF THE THEATER (3) *Professor W. S. Smith*
DRAM. 441. EDUCATIONAL DRAMATICS (CHILDREN'S ENTERTAINMENT) (3)
DRAM. 442S. EDUCATIONAL DRAMATICS (3)
DRAM. 443S. EDUCATIONAL DRAMATICS (ADVANCED MARIONETTES) (3)
DRAM. 451. DIRECTING (3) *Professor R. D. Reifsneider*
DRAM. 470. DRAMATICS IN THE SCHOOLS (3) *Professor W. S. Smith*
DRAM. 480. RADIO DRAMA (3)
DRAM. 481. ADVANCED RADIO DRAMA (3)

ECONOMICS

PROFESSOR WILLIAM N. LEONARD, A.M., Ph.D.
Head of the Department

ECON. 500. ECONOMICS SEMINAR (3-6) Seminar 3 hours.

ECON. 501. ECONOMICS SEMINAR (3-6) Seminar 3 hours.

ECON. 502. VALUATION OF PUBLIC UTILITIES (3) *Professor F. H. Cook*

ECON. 503. PRICES AND PROFITS (3)

ECON. 504. PROBLEMS OF CORPORATION FINANCE (3) *Professor G. L. Leffler*

ECON. 505. TRANSPORTATION SEMINAR (3) Prerequisite: Com. 15. Seminar 3 hours. *Professor R. H. Waters*

ECON. 507. INTERNATIONAL ECONOMIC RELATIONS (3) *Professor W. M. Hench*

ECON. 508. BANKING PROBLEMS (3) *Professor D. H. McKinley*

ECON. 509. TAXATION PROBLEMS (3) *Professor R. S. Stout*

ECON. 510. DEMAND ANALYSIS (3)

ECON. 511. ECONOMIC BASES FOR CONTROL OF INDUSTRIAL DISPUTES (3) Prerequisites: Econ. 1 or 14, 15. Lecture 3 hours. *Professor E. A. Myers*

ECON. 512. WAGES (3) *Professor D. S. Brown*

ECON. 515. LABOR SEMINAR (3) *Professor A. H. Reede*

ECON. 520. ADVANCED ECONOMIC STATISTICS (3) Prerequisites: 6 credits in economics and 3 in statistics. *Professor R. B. Saylor*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ECON. 400. HISTORY OF ECONOMIC THOUGHT (3)
ECON. 401. RECENT ECONOMIC THOUGHT (3)
ECON. 402. ADVANCED ECONOMIC THEORY (3)
ECON. 403. ADVANCED ECONOMIC THEORY (3)

Econ. 410.	Economics of Consumption (3)	*Professor S. Keyes*
Econ. 411.	Economics of Labor Relations (3)	*Professor E. A. Myers*
Econ. 412.	Economics of Collective Bargaining (3)	*Professor A. S. Luchek*
Econ. 414.	Economics of Labor Legislation (3)	*Professor E. A. Myers*
Econ. 415.	Social Insurance (3)	*Professor A. H. Reede*
Econ. 416.	Management of Labor Relations (3)	*Professor D. S. Brown*
Econ. 417.	International Commercial Policies (3)	*Professor W. M. Hench*
Econ. 418.	Elementary Wage Theory (3)	*Professor D. S. Brown*
Econ. 419.	Case Studies in Labor-Management Relations (3)	*Professor A. H. Reede*
Econ. 420.	Investments (3)	*Professor G. F. Mitch*
Econ. 421.	Central Banking Systems (3)	*Professor D. H. McKinley*
Econ. 422.	Investment Banking (3)	*Professor G. L. Leffler*
Econ. 423.	Pennsylvania Local Finance (3)	*Professor R. S. Stout*
Econ. 424.	Pennsylvania State Finance (3)	*Professor R. S. Stout*
Econ. 425.	The Money Market (3)	*Professor D. H. McKinley*
Econ. 430.	National Planning (3)	*Professor S. Keyes*
Econ. 435.	Problems of Federal Finance (3)	*Professor R. S. Stout*
Econ. 450.	The Business Cycle (3)	
Econ. 490.	Economic Statistics (3)	*Professor R. B. Saylor*

EDUCATION

Professor P. C. Weaver, M.Ed., Ph.D.
Acting Head of the Department

Ed. 501. Introduction to the Advanced Study of Education (1-3) Methods of educational research; criticism of studies and theses in education; initiating research projects; summarizing the results of research. Prerequisite: Ed. 470 or Psy. 415. Lecture 1 to 3 hours.

Ed. 515. Comparative Education (3) International approach to the study of education; special attention to England, France, Germany, Italy, Japan, and Russia; Latin-American culture. Prerequisite: Psy. 14. Lecture 3 hours.
Professor C. D. Champlin

Ed. 517. Evolution of Educational Thought (2-3) Rise of formal educational philosophy from Plato to John Dewey; preliminary reference to Chinese, Hindu, Chaldean, Persian, Hebrew, and Egyptian theories. Prerequisite: graduate maturity. Lecture 2 or 3 hours. *Professor C. D. Champlin*

Ed. 522. Production of Educational Moving Pictures (1-3) Nonlaboratory course on production techniques from the sponsor's viewpoint; script writing; photography, editing, sound recording. Prerequisites: Ed. 424, 487 (Unit B). Conference 1 hour, alternate weeks by appointment. Practicum 1 to 5 hours.
Professor A. W. VanderMeer

Ed. 523. Laboratory in Organizational Aspects of Materials of Instruction (1-3) Organizing, storing, circulating, and maintaining instructional materials

in an instructional materials library. Prerequisites: Ed. 424, 585. Conference 1 hour, alternate weeks by appointment. Practicum 1 to 5 hours.

Professor A. W. VanderMeer

Ed. 524. Seminar in Curriculum Materials and Their Utilization (3) Advanced detailed analysis of mass communication media; relationships among these and educational objectives, individual differences in learners, and ideas to be communicated. Prerequisites: Ed. 424, 585, 6 hours of educational psychology. Lecture 3 hours. *Professor A. W. VanderMeer*

Ed. 525. Modern Tendecies in Educational Method (2-3) Study of science supporting dynamic instruction; principles of teaching as guides; analysis of modern procedures; understanding of learning; substance versus plans. Prerequisite: 12 semester hours of undergraduate work in education.

Professor F. A. Butler

Ed. 527. Problems in the Education of the Mentally Retarded (1-4) Study of existing curricula, instructional practices, educational programs; experimentation in curriculum building and materials construction. Prerequisites: Ed. 426 and teaching experience, Ed. 427 or 583, Unit P. Lecture 1 to 4 hours.

Ed. 532. Supervision of Student Teachers (3) A course in supervision for master teachers, department heads, and college teachers with supervisory responsibilities in teacher education. Prerequisite: experience in teaching and 18 credits in education, including at least 5 in methods. Lecture 3 hours. *Professor F. E. Taylor*

Ed. 534a. Reading Clinic Practice: Analysis of Reading Disabilities (1-9) A laboratory course consisting of analysis of extreme reading disabilities and recommended remedial procedures; experience in preparation of case reports. Prerequisite: Ed. 432g or Psy. 550.

Ed. 534b. Reading Clinic Practice: Remedial Procedures (1-9) Practicum in special classes for reading disabilities; corrective and remedial procedures; specific procedures for correction of various types of reading disabilities. Prerequisite: Ed. 432g or 534a.

Ed. 535. Seminar on Reading Instruction (2-12) Designed to appraise significant researches and to outline procedures and materials for research; reading readiness, word perception, basic reading skills, vocabulary development. Prerequisite: Ed. 432b or 432c.

Ed. 536. Reading Clinic Research (1-15) Prerequisites: Ed. 432b; or Ed. 432c, 432g.

Ed. 540. Problems of Elementary Education (2-3) A problems seminar for experienced educators. Prerequisite: 12 credits in education and psychology, including 6 credits in elementary education. *Professor P. W. Bixby*

Ed. 541. Seminar in Contemporary Issues in Elementary Education (1-3) Conferences and discussions designed to meet the needs of experienced teachers and principals in the field of elementary education. Prerequisite: 6 credits in elementary education and teaching experience. Lecture 1 to 3 hours.

ED. 546. ELEMENTARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3)
Professor P. W. Bixby

ED. 548. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3) Principles underlying curriculum construction. Primarily for elementary education majors. Prerequisite: Ed. 31 or teaching experience. Lecture 2 or 3 hours.
Professor P. W. Bixby

ED. 550. PROBLEMS IN MODERN SECONDARY EDUCATION (1-4) Historical, psychological, social, and economic factors influencing secondary education; required as basic course of all graduate students in secondary education. Prerequisite: Ed. 450 or secondary school teaching. *Professor F. A. Butler*

ED. 551. SEMINAR IN CONTEMPORARY ISSUES IN SECONDARY EDUCATION (2-9)

Unit A. The Secondary School Curriculum (2-3) Principles and philosophy of curriculum construction. Each student works out an individual problem in the secondary school curriculum. Prerequisites: 12 credits in education and psychology, and teaching experience. *Professor J. H. Moyer*

Unit B. Laboratory Studies in Application of Educational Method (2-3) Analysis and application of outstanding studies in secondary education; integration of results of educational research with public school procedures. Prerequisites: 12 credits in education and psychology, and teaching experience.

Unit C. Organization and Administration of Secondary Education (2-3) Problems in the reorganization of secondary education, with particular reference to philosophy, organization, and teaching problems of the junior high school. Prerequisites: 12 credits in education and psychology, and teaching experience.

ED. 556. THE SECONDARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3) Improvement of instruction; improvement of teachers in service; evaluation of teaching procedures; methods of supervision; selection and use of textbooks. Prerequisite: three years' teaching experience. Lecture 2 or 3 hours. *Professor M. J. Wyland*

ED. 561. THE COMMUNITY COLLEGE AND POST-SECONDARY SCHOOL EDUCATION (2-3) The philosophy, organization, and character of school programs needed to meet the educational needs of individuals who desire to continue their education on the post-secondary school level. Prerequisites: Ed. 450, 480, 550; Psy. 414 or educational experience. *Professor P. C. Weaver*

ED. 562. THE INSTRUCTIONAL PROGRAM IN COMMUNITY COLLEGES AND POST-SECONDARY EDUCATION (2-3) Course offerings, curricula, instructional materials and procedures, guidance, extracurricular activities, student personnel, evaluation of results, and faculty qualifications. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience. Lecture 2 or 3 hours. *Professor P. C. Weaver*

ED. 563. THE PROFESSIONAL EDUCATION OF TEACHERS (3) Development and present status of teacher education; objectives and standards; selection and guidance of students; personnel problems in relation to staff. Prerequisite: 6 credits in advanced courses in education and a course in educational psychology. Lecture 3 hours.

ED. 567. PROBLEMS IN COLLEGIATE EDUCATION (2-3) Relationships between higher education and educational program as a whole; historical developments of higher education; functions of various types of higher institutions. Prerequisite: Psy. 14. Lecture 2 or 3 hours. *Professor P. C. Weaver*

ED. 568. PROBLEMS IN COLLEGIATE EDUCATION (2-3) Aims and objectives of higher institutions; principles and current trends in curriculum construction; general education; selection of students; guidance and personnel. Prerequisite: Psy. 14. *Professor P. C. Weaver*

ED. 569. SEMINAR IN COLLEGIATE EDUCATION (1-6) Special topics in higher education. Prerequisite: Ed. 567. Lecture 1 to 6 hours. *Professor P. C. Weaver*

ED. 574. ADVANCED EDUCATIONAL STATISTICS (2-4) Appropriate measures and devices for experimental research in education including correlation measures, curve fitting, and the analysis of variance. Prerequisite: 12 credits of graduate work in education including Ed. 470 or Psy. 415. Lecture 2 to 4 hours.

ED. 575. ADMINISTRATION AND SUPERVISION IN BUSINESS EDUCATION (3) Work of administrators, supervisors, and others responsible for improvement of instruction in business education; use of vocational testing; job analysis. Prerequisite: 6 credits in secondary education. Lecture 3 hours. *Professor James Gemmell*

ED. 576. INTRODUCTION TO RESEARCH IN BUSINESS EDUCATION (3) Methods of research in business education; opportunity to compile annotated bibliographies on current problems; analysis and evaluation of significant research. Lecture 3 hours. *Professor James Gemmell*

ED. 577. EVALUATION OF RESEARCH AND EMPIRICAL LITERATURE IN BUSINESS EDUCATION (3) Application of evaluation methods to current literature in business education; special attention to research studies. Prerequisite: Ed. 576. Lecture 3 hours. *Professor James Gemmell*

ED. 578. SEMINAR IN BUSINESS EDUCATION (3) Intended for graduate students preparing theses or final documents, or for those working on special studies in business education. Prerequisite: Ed. 577. Lecture 3 hours. *Professor James Gemmell*

ED. 580. SEMINAR IN SCHOOL ADMINISTRATION (1-6) Efficiency in supervision, methods of diagnosis and evaluation of teaching and learning procedure, improving instruction, maintaining teacher morale, stimulating co-operative work. Prerequisites: Ed. 25, 31, 480, or teaching experience. Recitation 1 to 6 hours.

ED. 582. EDUCATIONAL SURVEY TECHNIQUES (2-3) How to make school surveys; students are expected to make a survey in the local school system during the following year. *Professor W. S. Vincent*

ED. 583. PROBLEMS IN ADMINISTRATION AND SUPERVISION (2-21)

Unit A. The Educational Plant (2) *Professor W. S. Vincent*

Unit B. Public Relations for School Administrators (2-3) *Professor W. S. Vincent*

Unit C. Public School Finance (2-3) *Professor W. S. Vincent*

Unit I. Administration of Adult Education in the Public Schools (3) *Professor W. S. Vincent*

Unit M. Legal Aspects of School Administration (3) *Professor W. S. Vincent*

Unit P. The Administration of Public School Education for Atypical children (2) *Professor M. A. Neuber*

Unit Q. Dynamic Factors in School Administration (2) *Professor W. S. Vincent*

Unit R. Public School Business Administration (2-3) *Professor W. S. Vincent*

Ed. 585. Curriculum Construction (2-3) Principles and procedures in curriculum construction; functions of administrator, supervisor, and teacher in curriculum construction.

Ed. 586. Principles of School Supervision (2-3) Organization of supervision; planning the supervisory program; developing standards of teaching and learning; improvement of learning through tests and teacher rating. Prerequisites: 18 credits in education and 3 years' teaching experience. Lecture 2 or 3 hours.

Ed. 587. The Secondary School Principal as Administrator (2-4) Problems of schedule making, teachers' meetings, curriculum making and revision, organization of extracurricular and guidance programs. Prerequisite: teaching experience. *Professor M. J. Wyland*

Ed. 589. The Elementary School Principal as Administrator (2-3) The duties of the elementary school principal in organizing and administering his school. Prerequisite: Ed. 442. Lecture 2 or 3 hours. *Professor P. W. Bixby*

Ed. 590. The Philosophy of Education (2-4) Fundamental principles; scientific sanctions of progressive instructional practices and professional experiences as bases for formulation of the educational creed. Prerequisite: 18 credits in education. Lecture 2 to 4 hours. *Professor C. D. Champlin*

Ed. 594. Seminar in Education (1-6) Conferences and discussions designed to meet the need for special study of particular fields in education. Prerequisite: requirements for graduation in education.

Ed. 595. Educational Research (1-15) An inductive research from primary sources expected to maintain standards sufficiently high to warrant publication of the findings. Prerequisite: at least 6 hours of graduate study in education, including some work in statistics.

Ed. 597S. Workshop in Current Educational Problems (1-6) For administrators, supervisors, experienced elementary and secondary teachers, guidance workers; administrative, supervisory, and instructional problems involved in an emerging educational program. Prerequisite: 12 credits of graduate work in education. Lecture 1 to 6 hours. *Professor M. J. Wyland*

Ed. 599. Thesis (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ED. 412, 412X. HISTORY OF MODERN EUROPEAN EDUCATION (3)
Professor C. D. Champlin

ED. 413, 413X. HISTORY OF EDUCATION IN THE UNITED STATES (2-3)
Professor C. D. Champlin

ED. 414. HISTORY OF EDUCATION IN PENNSYLVANIA (2-3)
Professor C. D. Champlin

ED. 415S, 415X. MODERN TENDENCIES IN AMERICAN EDUCATION (1-6)

ED. 416X. SOCIAL EDUCATION (3)

ED. 421X. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3)

ED. 424, 424X. VISUAL AND OTHER SENSORY AIDS FOR TEACHERS (1-3)
Professor A. W. VanderMeer

ED. 425S, 425X. THE SCIENTIFIC DIRECTION OF LEARNING ACTIVITIES (2-4)

ED. 426, 426X. EDUCATION OF EXCEPTIONAL CHILDREN (2-3)
Professor M. A. Neuber

ED. 427. EDUCATION OF THE MENTALLY RETARDED (2-3) *Professor M. A. Neuber*

ED. 428, 428X. UNITS A, B, C. ADULT EDUCATION: ORGANIZATION, TYPES, AND METHODS (1-3) *Professor C. D. Champlin*

ED. 429, 429X. THE GIFTED CHILD (1-3) *Professor M. A. Neuber*

ED. 431, 431X. PRINCIPLES AND METHODS OF TEACHING SAFETY EDUCATION (3)

ED. 432b, 432bX. THE ELEMENTARY SCHOOL READING PROGRAM (2-3)

ED. 432c, 432cX. READING PROBLEMS IN THE SECONDARY SCHOOL (2-3)

ED. 432d, 432dX. SPECIAL PROBLEMS IN THE TEACHING OF ELEMENTARY SCHOOL ENGLISH (2-3)

ED. 432eX. CHORAL SPEAKING (3)

ED. 432f, 432fX. TEACHING SECONDARY SCHOOL ENGLISH (2-3)

ED. 432g, 432gX. READING DISABILITIES (2-3)

ED. 432h, 432hX. TECHNIQUES IN REMEDIAL READING (2-6)

ED. 433e. ADVANCED THEORY OF KINDERGARTEN (3)

ED. 433f, 433fX. TEACHING CHILDREN'S LITERATURE (2-3)

ED. 433h, 433hX. PROBLEMS OF ELEMENTARY SCHOOL ARITHMETIC (2-3)
Professor M. A. Neuber

ED. 433n, 433nX. TEACHING SOCIAL STUDIES IN THE ELEMENTARY GRADES (2-3)
Professor F. E. Taylor

ED. 433w, 433wX. TEACHING SOCIAL STUDIES IN THE HIGH SCHOOL (2-3)
Professor A. W. VanderMeer

ED. 433y, 433yX. TEACHING MATHEMATICS IN THE SECONDARY SCHOOL (3)

ED. 435X. EDUCATION FOR CITIZENSHIP (2-3) *Professor C. D. Champlin*

ED. 438, 438X. TEACHING SCIENCE IN SECONDARY SCHOOLS (2-3)
Professor G. J. Free

ED. 438e, 438eX. TEACHING SCIENCE IN THE ELEMENTARY SCHOOL (1-3)
Professor G. J. Free

ED. 439, 439X. TEACHING TRAFFIC SAFETY AND AUTOMOBILE OPERATION (1-3)
Professor A. E. Neyhart, Mr. Joseph Intorre

ED. 441X. PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS (2-3)
Professor P. W. Bixby

ED. 442, 442X. ELEMENTARY EDUCATION (2-3) *Professor P. W. Bixby*

ED. 448X. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3) *Professor P. W. Bixby*

ED. 449aS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE ELEMENTARY SCHOOL (3) *Professor G. J. Free*

ED. 449bS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE SECONDARY SCHOOL (3) *Professor G. J. Free*

ED. 450X. SECONDARY EDUCATION (2-3) *Professor F. A. Butler*

ED. 451X. SPECIAL PROBLEMS OF THE HIGH SCHOOL TEACHER (2-3)

ED. 453, 453X. EDUCATIONAL AND VOCATIONAL GUIDANCE (2-3) *Professor M. J. Wyland*

ED. 454, 454X. EXTRACURRICULAR ACTIVITIES IN THE JUNIOR AND SENIOR HIGH SCHOOL (2-3) *Professor J. H. Moyer*

ED. 456, 456X. PRINCIPLES AND PROBLEMS IN BUSINESS EDUCATION (1-3) *Professor James Gemmell*

ED. 459, 459X. IMPROVEMENT OF INSTRUCTION IN BUSINESS SKILL SUBJECTS (1-3) *Professor James Gemmell*

ED. 460. CURRICULA IN BUSINESS EDUCATION (3) *Professor James Gemmell*

ED. 461. IMPROVEMENT OF INSTRUCTION IN BASIC BUSINESS SUBJECTS (3) *Professor James Gemmell*

ED. 462. TEACHING SHORTHAND AND TYPEWRITING (3) *Professor James Gemmell*

ED. 463. BOOKKEEPING FOR TEACHERS (3) *Professor James Gemmell*

ED. 466. TEACHING OF OFFICE PRACTICE (3) *Professor James Gemmell*

ED. 467. TEACHING OF SHORTHAND (2-3) *Professor James Gemmell*

ED. 468. TEACHING OF TYPEWRITING (2-3) *Professor James Gemmell*

*ED. 470, 470X. EDUCATIONAL MEASUREMENTS (2-3)

ED. 474, 474X. TEACHING OF OCCUPATIONS (2-3)

ED. 480, 480X. EDUCATIONAL ADMINISTRATION (2-3) *Professor W. S. Vincent*

ED. 482X. SUPERVISION AND IMPROVEMENT OF INSTRUCTION (2-3)

ED. 485X. CURRICULUM CONSTRUCTION (2-3)

ED. 487, 487X. PROBLEMS IN VISUAL AND OTHER SENSORY AIDS IN EDUCATION (1-9) Unit A (1-3), Unit B (1-2), Unit C (1-2), Unit D (1-2) *Professor A. W. VanderMeer*

ED. 490X. PHILOSOPHY OF EDUCATION (3) *Professor C. D. Champlin*

ED. 493, 493X. CHARACTER EDUCATION AND GUIDANCE (2-3) *Professor C. D. Champlin*

ED. 494. RELIGIOUS EDUCATION (2-3)

ED. 497S, 497X. WORKSHOP IN SELECTED STUDIES IN THE FIELD OF ELEMENTARY AND SECONDARY EDUCATION (1-6) *Professor M. J. Wyland and Staff*

ED. 499, 499X. PROBLEMS OF SPECIAL EDUCATION (3) *Professor M. A. Neuber*

ELECTRICAL ENGINEERING

PROFESSOR ERIC A. WALKER, M.S., SC.D.
Head of the Department

E.E. 520. SEMINAR (1) Required of all graduate students in electrical engineer-

* No credit if credit has been received for Ed. 70.

ing. Conferences, reading, and presentation of technical papers.

E.E. 521a,b,c,d. Alternating-Current Theory (2-12) Special problems in alternating-current theory and the application of these problems to alternating-current circuits or machinery at any frequencies. Lecture and investigations 2 to 12 hours.

E.E. 522. Power Generation (3) Problems of the generating station in the electrical power system including economic and technical considerations of station location, operation, and control; selection and layout of equipment. Lecture 3 hours. *Professor A. P. Powell*

E.E. 523. Transients in Linear System (3) Transient response of linear electric circuits and electromechanical systems including the application of operational methods of analysis to electrical and electromechanical problems. Prerequisite: E.E. 423. Lecture 3 hours. *Professor C. B. Holt*

E.E. 524. Engineering Electronics (3) Special problems dealing with the design and application of electronic devices and systems; emphasis upon individual projects closely related to other phases of the student's graduate program. Lecture 2 hours, practicum 3 hours. *Professor E. B. Stavely*

E.E. 525. Symmetrical Components (3) Polyphase circuits and machines under unbalanced conditions of operation including the effects of rotating machines upon the distribution and transmission system performance; characteristics of phase converters and single-phase operation of polyphase systems. Prerequisite: E.E. 425. Lecture 3 hours. *Professor C. B. Holt*

E.E. 526a,b. Electric Illumination (3-6) Problems in photometry; methods of evaluating illumination in terms of safety and seeing value; development of improved methods for illumination calculations.

E.E. 527. Electrical Design Engineering (3) Special problems in the design of alternating and direct-current apparatus. Lecture and design 3 hours.

E.E. 528. Servomechanisms (3) An advanced treatment of the transient and steady-state behavior of closed-cycle control systems with special attention to stability and the design of stabilizing controllers. Prerequisite: E.E. 428. *Professor H. I. Tarpley*

E.E. 529a,b. Precision Measurements (3-6) Advanced measurements in electricity and magnetism, usually involving the development of laboratory techniques applicable to specific research problems; development of special measuring devices.

E.E. 530. Audio Frequency Engineering (3) Electrical systems and equipment used in production, recording, amplification, transmission, and measurement of sound. Prerequisite: E.E. 11 or 13. *Professor F. T. Hall, Jr.*

E.E. 531a,b,c. Radio Frequency Engineering (3-9) Radio frequency equipment, measurements, and systems; amplifiers, modulators, demodulators, transmitters, receivers, transmission lines, antennae, and radiators. Prerequisite: E.E. 431. *Professor F. T. Hall, Jr.*

E.E. 532. Ultra-High-Frequency Engineering (4) Theory of transmission lines, wave guides, resonant cavities, antennae, and wave propagation. Prerequisite: E.E. 432. Lecture 3 hours, practicum 3 hours. *Professor F. T. Hall, Jr.*

E.E. 533. Automatic Control Systems (2-3) Automatic control as applied to railway and industrial motors; telemetering and automatic control of electrical, mechanical, thermal, and chemical quantities. Investigation of existing methods and design of equivalent systems. Much of the course may be adapted to the needs of special interests. Prerequisite: E.E. 4. *Professor P. X. Rice*

E.E. 535. Engineering Analysis (3) The engineering applications of functions of a complex variable, including conformal mapping methods for plotting potential fields, the Laplace transform method for analyzing circuit problems, analysis of stability of servomechanisms. Prerequisite: E.E. 435. Lecture 3 hours. *Professor Norman Davids*

E.E. 538. Electromagnetic Engineering (3) Electrical and magnetic fields, using the Maxwell-Lorentz equations as applied to vector fields and special solutions for antennae, wave guides, and other engineering applications. Prerequisite: E.E. 438. Lecture 3 hours. *Professor D. Van Meter*

E.E. 550. Communication Networks (3) Methods of filter design using lattice networks; the effects of dissipation on the characteristics of filter networks; transient response of networks and the design of equalizers. Prerequisite: E.E. 450. Lecture 3 hours. *Professor H. I. Tarpley*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

E.E. 421a,b,c,d. Electrical Engineering Problems (2-12)
E.E. 423. Transient Phenomena (3) *Professor C. B. Holt*
E.E. 424. Engineering Electronics (3) *Mr. W. R. Smith, Professor P. E. Shields*
E.E. 425. Symmetrical Components (3) *Professor C. B. Holt*
E.E. 428. Servomechanisms (3) *Professor H. I. Tarpley*
E.E. 431. Vacuum-Tube Circuits (3) *Professor D. Van Meter*
E.E. 432. Ultra-High-Frequency Techniques (3) *Professor F. T. Hall, Jr.*
E.E. 434. Industrial Electronics (3) *Professor E. B. Stavely*
E.E. 435. Engineering Analysis (3) *Professor H. I. Tarpley*
E.E. 438. Electricity and Magnetism (3)
E.E. 450. Electrical Network Theory (3) *Professor H. I. Tarpley*
E.E. 460. High-Voltage Engineering (3) *Professor R. E. Armington*

ENGINEERING

Consult Dean H. P. Hammond, C.E., D.Eng., LL.D.

The following course may be taken for graduate credit under the restrictions in force:

Eng. 400. Production Engineering (3)

ENGINEERING EXPERIMENT STATION

PROFESSOR F. GEORGE HECHLER, M.E.
Director

ENG. EXP. STA. 501. FUEL INJECTION AND COMBUSTION IN DIESEL ENGINES (2-6) Characteristics and efficiency of various injection systems. Lecture 3 hours.
Professor P. H. Schweitzer

ENG. EXP. STA. 502. DIESEL ENGINE RESEARCH (3-15 per semester) An original investigation dealing with the design, construction, operation, or application of Diesel engines. *Professor P. H. Schweitzer*

ENG. EXP. STA. 504. FUEL SPRAY LABORATORY (2) A laboratory study of fuel injection for the Diesel engine. *Professor R. L. Stanley*

ENG. EXP. STA. 505. TRANSIENT ELASTIC PHENOMENA (2-3) The analysis, mainly by graphical methods, of transient phenomena in the flow of fluids in pipes with particular attention to the phenomena of injection in Diesel engines; water-hammer in hydraulic conduits; oscillations in the intake and exhaust pipes of engines and compressors; surges in mechanical springs; surges in electric circuits. Lecture 2 or 3 hours. *Professor K. J. DeJuhasz*

ENG. EXP. STA. 506. RESEARCH IN TRANSIENT ELASTIC PHENOMENA (3-15 per semester) Laboratory research in the fields described under Eng Exp. Sta. 505.
Professor K. J. DeJuhasz

ENG. EXP. STA. 507. SCAVENGING OF TWO-STROKE CYCLE ENGINES (3) Design of ports, valves, blowers, intake and exhaust manifolds for proper scavenging and charging of engines, particularly two-stroke cycle Diesel engines; experimental technique in evaluating scavenging. Prerequisite: M.E. 107 or 413. Lecture 3 hours.
Professor P. H. Schweitzer

ENG. EXP. STA. 508. FUEL FEEDING DEVICES FOR INTERNAL COMBUSTION ENGINES (3) Carburetors and injection equipment for Otto and Diesel engines and for liquid-fuel turbines, including the required control devices. Lecture 3 hours.
Professor W. E. Meyer

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ENG. EXP. STA. 401. THEORY OF ENGINEERING INSTRUMENTS (2-3)
Professor K. J. DeJuhasz

ENGINEERING MECHANICS

PROFESSOR JOHN A. SAUER, M.S., Ph.D.
Head of the Department

MCHS. 500. ADVANCED MECHANICS OF MATERIALS (3-6) Strain energy methods; special problems in bending and torsion; curved bars, beams on elastic foundations;

thick-walled cylinders, shrink-fit assemblies, and rotating discs; thin-walled pressure vessels; bending of thin plates; buckling of bars and plates. Prerequisite: Mchs. 13.
Professors J. Marin, D. E. Hardenbergh

Mchs. 504. Applied Elasticity (3) Analyses of stress and strain in two dimensions; problems in elasticity and elastic stability; emphasis on applications to machine and structural design. Prerequisite: Mchs. 13. *Professor J. Marin*

Mchs. 506. Experimental Stress Analysis (3) Experimental methods of stress determination including photoelasticity, stress coat and electric strain gauge techniques; stress analogies; strain rosettes for combined stress determinations. Prerequisite: Mchs. 13. Lecture 2 hours, practicum 2 hours. *Professor J. Marin*

Mchs. 507. Theory of Elasticity and Applications (3-6) General equations of stress and strain; applications to beams, curved members, rotating discs, thick cylinders, torsion members, plates, and other structural and machine parts. Prerequisite: Mchs. 13. Lecture 3 to 6 hours. *Professor J. A. Sauer*

Mchs. 508. Theory of Elastic Stability and Applications (3) Buckling of slender and short members; buckling of I-beams; stability of thin-walled constructions; thin-walled cylinders subjected to internal pressures; applications to structural parts including aircraft members. Prerequisites: Mchs. 12, 13.

Mchs. 509. Theory of Plates and Shells (3) Bending of circular and rectangular plates; buckling of plates; plates on elastic foundations; deformation of shells without bending; applications to engineering problems. Prerequisite: Mchs. 13.

Mchs. 512. History of Mechanics of Materials (2) Prerequisite: Mchs. 13.

Mchs. 513. Thesis (1-9)

Mchs. 514. Engineering Mechanics Seminar (1 per semester) Current literature and special problems in engineering mechanics. *Professor P. K. Roos*

Mchs. 515. Research in Engineering Mechanics (1-15 per semester) Investigation of a theoretical or experimental project in engineering mechanics.

Mchs. 520. Advanced Dynamics (3) Dynamics of a particle and of rigid bodies: Newtonian equations in moving co-ordinate systems; LaGrange's and Hamilton's equations of motion; special problems in vibrations and dynamics. Prerequisites: Mchs. 12, Math. 84 or 431. *Professor J. A. Sauer*

Mchs. 522. Theory of Vibrations (3) Mathematical theory of vibrating systems: damping phenomena; forced vibrations; analogy between mechanical and electrical vibrations; transverse and torsional oscillation of shafts; vibration of strings, beams, membranes, and plates. Prerequisites: Mchs. 13, Math. 84 or 431.
Professors J. A. Sauer, R. K. Vierck

Mchs. 523. Vibration Problems in Engineering (3) Application of vibration theory to problems of suspension; vibration isolation in machines, ships, and automobiles; torsional oscillation of crankshafts; vibrations of bridges, turbine blades, propeller blades; self-induced vibrations; nonlinear vibrational systems and applications. Prerequisite: Mchs. 522.

MCHS. 530. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) True stress-strain relations in tension; plastic stress-strain equations for combined stresses; theories of failure for static and fatigue stresses; impact loads; creep of metals; applications to structural and machine design. Prerequisite: Mchs. 14.
Professor J. Marin

MCHS. 531. THEORY OF PLASTICITY AND APPLICATIONS (3) Theory of plasticity including plastic torsion and bending of bars; thick-walled cylinders and rotating discs; buckling of bars and residual stresses; mechanics of creep. Prerequisite: Mchs. 504 or 507. *Professor J. Marin*

MCHS. 533. DETERMINATION OF MECHANICAL PROPERTIES (3) Experiments in fatigue, creep, impact, and combined stresses; true stress-strain diagrams. Lecture 1 hour, practicum 6 hours. *Professors P. K. Roos, P. B. Kapp*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MCHS. 400. ADVANCED STRENGTH OF MATERIALS (3)
Professors J. Marin, D. E. Hardenbergh
MCHS. 401. ELEMENTS OF VIBRATIONS (3) *Professors R. K. Vierck, J. A. Sauer*
MCHS. 402. APPLIED AND EXPERIMENTAL STRESS ANALYSIS (3) *Professor J. Marin*
MCHS. 403. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3)
Professors J. Marin, J. W. Breneman
MCHS. 404. RESEARCH IN ENGINEERING MECHANICS (1-6)

ENGLISH COMPOSITION

PROFESSOR THEODORE J. GATES, M.A.
Head of the Department

ENGL. COMP. 502. ANCIENT AND MEDIEVAL RHETORIC AND POETIC (3) Rhetorical and poetic doctrine of ancient and medieval times. Recitation 3 hours.
Professor F. B. Krauss

ENGL. COMP. 504. RENAISSANCE AND MODERN RHETORIC (3) The rhetorical and poetic doctrine of Renaissance and modern times. Recitation 3 hours.
Professor J. J. Rubin

ENGL. COMP. 510. PROSE STYLE (3) The development of English prose style from the Elizabethan age to Dryden. Recitation 3 hours. *Professor J. C. Major*

ENGL. COMP. 511. MODERN PROSE STYLE (3) English prose style from 1700 to the present. A continuation of Engl. Comp. 510. Recitation 3 hours.
Professor J. C. Major

ENGL. COMP. 529. HISTORICAL ENGLISH GRAMMAR (3) The evolution of the grammatical system of English. Recitation 3 hours. *Professor L. F. Peck*

ENGL. COMP. 530. RHETORICAL TECHNIQUES (3) Studies in the techniques of special types of writing, such as humor, satire, and propaganda. Prerequisites: 12 credits

in English or American literature and 12 credits in English composition. Recitation 3 hours. *Professor H. F. Graves*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ENGL. COMP. 404. PUBLIC OPINION AND WRITTEN PERSUASION (3) *Professor H. F. Graves*

ENGL. COMP. 410a,b,cS. SURVEY OF ENGLISH COMPOSITION (1-3)

ENGL. COMP. 411a,b,cS. SPOKEN AND WRITTEN ENGLISH (1-3)

ENGL. COMP. 418. THE WRITING OF LITERARY CRITICISM (3) *Professor J. J. Rubin*

ENGLISH LITERATURE

PROFESSOR BRICE HARRIS, M.A., Ph.D.
Head of the Department

ENGL. LIT. 501. MATERIALS AND METHODS OF RESEARCH FOR ENGLISH LITERATURE (3) The bibliography of literary history and criticism; methods of editing and annotating texts; the form and materials of dissertations. Required of all graduate students with an English literature major. *Professor C. O. Ridenour*

ENGL. LIT. 505. THE AMERICAN SHORT STORY (3) Lecture 3 hours. *Professor W. L. Werner*

ENGL. LIT. 506. HISTORY OF AMERICAN POETRY (3) Lecture 3 hours. *Professor W. L. Werner*

ENGL. LIT. 507. RESEARCH PROBLEMS IN ENGLISH (1-6) The methods of research in English, the problems of bibliography, and the method of evaluating sources and materials. Lecture 1 to 6 hours.

ENGL. LIT. 508. BEOWULF (3) A reading of the text and a study of the prominent literary problems and relationships. Prerequisite: Engl. Lit. 31. Lecture 3 hours. *Professor D. S. Mead*

ENGL. LIT. 509. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE PROSE WRITERS (3) *Professor D. S. Mead*

ENGL. LIT. 510. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE POETS (3) *Professor A. P. Locklin*

ENGL. LIT. 511. ELIZABETHAN DRAMA (3) Lecture 3 hours. *Professor Brice Harris*

ENGL. LIT. 512. HISTORY OF THE AMERICAN NOVEL (3) Lectures and reports. Lecture 3 hours. *Professor W. L. Werner*

ENGL. LIT. 513. AMERICAN ESSAYS (3) Lectures and reports on a special group of essayists. Lecture 3 hours. *Professor W. L. Werner*

ENGL. LIT. 514. SHAKESPEARE (3) Special problems in the works of Shakespeare. Lecture 3 hours. *Professor T. D. Bowman*

ENGL. LIT. 515. THE AGE OF SWIFT (3) Special studies varying from year to year. Lecture 3 hours. *Professor Brice Harris*

ENGL. LIT. 516. THE AGE OF JOHNSON (3) The work of Johnson and his circle. Lecture 3 hours. *Professor D. S. Mead*

ENGL. LIT. 517. BYRON, SHELLEY, AND KEATS (3) *Professor C. O. Ridenour*

ENGL. LIT. 518. PRE-ROMANTIC WRITERS (3) Development of Romantic ideas in the 18th century. *Professor C. O. Ridenour*

ENGL. LIT. 519. WORDSWORTH, COLERIDGE, SOUTHEY, AND SCOTT (3) *Professor C. O. Ridenour*

ENGL. LIT. 520. PROSE WRITERS OF THE ROMANTIC PERIOD (3) *Professor C. O. Ridenour*

ENGL. LIT. 531. OLD ENGLISH (3) Old English language and literature with lectures on Old English and Germanic philology. *Professor D. S. Mead*

ENGL. LIT. 532. MIDDLE ENGLISH (3) Middle English language and literature with lectures on the development of Old English through Middle English to modern times. *Professor D. S. Mead*

ENGL. LIT. 533. LITERARY CRITICISM (3) An historical survey of the principles of literary criticism.

ENGL. LIT. 540. CHAUCER (3) Analysis of Chaucer's poetry in the light of its background, sources, and subsequent influences. *Professor D. S. Mead*

ENGL. LIT. 543. CAVALIER AND ANGLICAN (3) The poetry and prose of the middle years of the 17th century from the death of Shakespeare to 1660. *Professor D. S. Mead*

ENGL. LIT. 544. RESTORATION LITERATURE (3) Selected studies in the writers in England between 1650 and 1700. *Professor Brice Harris*

ENGL. LIT. 545. THE PRE-RAPHAELITES (3) *Professor Mason Long*

ENGL. LIT. 546. TENNYSON AND BROWNING (3) *Professor Mason Long*

ENGL. LIT. 547. CARLYLE, RUSKIN, AND ARNOLD (3) *Professor Mason Long*

ENGL. LIT. 550. SELECTED STUDIES IN THE BRITISH NOVEL TO 1840 (3) *Professor T. D. Bowman*

ENGL. LIT. 551. SELECTED STUDIES IN THE BRITISH NOVEL FROM 1840 TO THE PRESENT (3) *Professor A. B. Sutherland*

ENGL. LIT. 580. PRE-SHAKESPEAREAN DRAMA (3) *Professor Brice Harris*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ENGL. LIT. 400. TEACHERS' COURSE IN LITERATURE (3) *Professor D. K. Merrill*

ENGL. LIT. 401. MAIN CURRENTS IN AMERICAN LITERATURE (3) *Professor D. K. Merrill*
ENGL. LIT. 423. FORMS AND MOVEMENTS OF BRITISH LITERATURE (3)
Professor C. O. Ridenour
ENGL. LIT. 439a,b,cS. OUR CONTEMPORARIES (3)
ENGL. LIT. 440a,b,cS. MASTERS OF LITERATURE (1-3)
ENGL. LIT. 441a,b,cS. MASTERS OF ENGLISH LITERATURE (1-3)
ENGL. LIT. 460. LITERARY BIOGRAPHY (3) *Professor D. K. Merrill*
ENGL. LIT. 464. SPENSER (3) *Professor A. P. Locklin*
ENGL. LIT. 466. MILTON (3) *Professor Brice Harris*
ENGL. LIT. 475a,b,cS. WORLD LITERATURE IN ENGLISH (3-9)
ENGL. LIT. 484. AMERICAN DRAMA (3) *Professor A. C. Cloetingh*
ENGL. LIT. 485. SCANDINAVIAN DRAMA (3) *Professor A. C. Cloetingh*
ENGL. LIT. 486. LATER BRITISH AND IRISH DRAMATISTS (3) *Professor A. C. Cloetingh*
ENGL. LIT. 487. MODERN CONTINENTAL DRAMA (3) *Professor A. C. Cloetingh*
ENGL. LIT. 489a,b,cS. COMPOSITE COURSE IN DRAMA (3-9)
ENGL. LIT. 489dS. CONTEMPORARY DRAMA (3)

ENTOMOLOGY

PROFESSOR EDWARD H. DUSHAM, M.S., Ph.D.
Head of the Department of Zoology and Entomology

ENT. 500. INSECT HISTOLOGY (5) The microscopic structure of insect tissues and organs. Prerequisites: Ent. 405, Zool. 31. Lecture 2 hours, practicum 7½ hours.
Professor G. B. Newman

ENT. 505. ADVANCED MORPHOLOGY OF INSECTS (3) Advanced work in either the external or internal morphology of insects. Prerequisite: Ent. 500. Practicum 9 hours.

ENT. 506. IMMATURE INSECTS (2) The morphology and taxonomy of the immature stages of insects. Prerequisites: Ent. 403, 405. Practicum 6 hours.
Professor S. W. Frost

ENT. 508. THE BIOLOGICAL CONTROL OF INSECTS (2) The artificial use of bacteria, fungous diseases, and animals in the control of injurious insects; methods and equipment for rearing parasites and predators on a large scale. Prerequisites: Ent. 6, 8, 407. Lecture 2 hours. *Professor S. W. Frost*

ENT. 509. ENTOMOLOGICAL TECHNIQUE (2) For advanced students dealing with special methods of collecting, rearing living insects, preparing and preserving immature stages, keeping records, and preparing illustrations for manuscript. Prerequisite: Ent. 6. Lecture 2 hours. *Professor S. W. Frost*

ENT. 514. ADVANCED SYSTEMATIC ENTOMOLOGY (1-15 per semester) Taxonomy of the various orders of insects selected to meet the needs of the individual student. Prerequisites: Ent. 403, 405. Practicum 3 to 45 hours per semester.

ENT. 528. INSECT PHYSIOLOGY (3) The normal functions of the insect body. Prerequisites: Ent. 405, Zool. 41. Lecture 3 hours. *Professor L. E. Dills*

ENT. 534. INSECT EMBRYOLOGY (2) The origin and development of the tissues and organs of insects. Prerequisite: Ent. 500. Lecture 2 hours. *Professor G. B. Newman*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ENT. 401. MEDICAL AND VETERINARY ENTOMOLOGY (3) *Professor H. W. Frings*
ENT. 403. SYSTEMATIC ENTOMOLOGY (3)
ENT. 405. INSECT MORPHOLOGY (3)
ENT. 407. INSECT ECOLOGY (3) *Professor S. W. Frost*
ENT. 413. ENTOMOLOGY SEMINAR (1 per semester) *Professor S. W. Frost*
ENT. 429. PRINCIPLES OF INSECT CONTROL (2) *Professor S. W. Frost*

FAMILY ECONOMICS AND HOME MANAGEMENT

PROFESSOR DELPHA E. WIESENDANGER, M.S.
Acting Head of the Department of Home Management, Housing, and Art

H. MGMT. 515, 515X. CONSUMER PROBLEMS (2-3) Methods of securing, evaluating, and presenting data concerning household commodities. Intended for those who teach home economics in high schools or colleges or who have charge of adult classes in this field. *Professor R. R. Honey*

H. MGMT. 524. ECONOMIC PROBLEMS OF THE HOUSEHOLD (3) Economic problems of the present-day family; special emphasis on factors in household production, use of money income, and standards of living. Prerequisites: H. Mgmt. 439, Econ. 14. Lecture 3 hours. *Professor R. R. Honey*

H. MGMT. 528. HOME MANAGEMENT SUPERVISION (2-3) Evaluation of objectives and techniques in the organization, supervision, and teaching of the home management house experience. Prerequisite: H. Mgmt. 439. Recitation 2 or 3 hours.

H. MGMT. 543. HOME MANAGEMENT IN RELATION TO FAMILY LIVING (3) Ways in which families manage; an opportunity to work with families in the solution of their management problems as a means of helping the student clarify her thinking in relation to the entire field of family management. Prerequisite: 6 credits of home management or family economics courses in home economics. *Professor D. E. Wiesendanger*

H. MGMT. 544. SPECIAL PROBLEMS IN HOUSE MANAGEMENT (3) Specific management problems, such as social, financial, and material, including the development of college level teaching aids. Prerequisite: 6 credits of home management or family economics courses in home economics. *Professor D. E. Wiesendanger*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

H. MGMT. 439, 439X. HOME MANAGEMENT (2) *Professor M. E. Starr*

H. Mgmt. 442. Resident Experience in Home Management (3) Room and board will be charged at regular rates. *Professor M. E. Starr*

H. Mgmt. 445. Home Management Experience (3) *Professor M. E. Starr*

H. Mgmt. 477. Family Management (3)

FOODS, NUTRITION, AND HEALTH

Professor Mary L. Dodds, M.S., Ph.D.
Acting Head of the Department

Fd. Ntr. 520. Readings in Foods (3) Readings and discussion of selected food problems.

Fd. Ntr. 521. Seminar in Foods (1-6) Discussion and reports on current research in the foods field. Prerequisite or concurrent: Fd. Ntr. 520.

Fd. Ntr. 522. Individual Food Problems (2-6) Intensive study of specific problems in food preparation. Prerequisite: Fd. Ntr. 420. Conference 1 hour, practicum 5 hours.

Fd. Ntr. 523. Economic and Nutritional Phases of Menu Planning (2-4) Food expenditures in relation to nutritional value and income. Prerequisites: Fd. Ntr. 450, Econ. 14.

Fd. Ntr. 550. Readings in Nutrition (3) Readings and reports of selected topics in nutrition. Prerequisite: Fd. Ntr. 450. Recitation 3 hours.

Fd. Ntr. 551. Nutrition Seminar (3-6) Selected topics and recent advances in nutrition. Prerequisite: Fd. Ntr. 450. Recitation 3 to 6 hours.

Fd. Ntr. 552. Diet in Diseases (3) Reports and discussions of the problems of adaptation of diet to disorders of nutrition. Prerequisites: Fd. Ntr. 450. Lecture 3 hours.

Fd. Ntr. 553. Nutrition of Children (3) The nutritional needs of the normal child during prenatal life, infancy, and childhood. Prerequisites: Agr. Biochem. 35, Fd. Ntr. 450. Lecture 3 hours.

Fd. Ntr. 554. Techniques in Human Nutrition Research (3) The more usual techniques employed by the research worker in human nutrition, accompanied by directed experience in their use and interpretation. Prerequisite or concurrent: Fd. Ntr. 551. Lecture 2 hours, practicum 3 hours.

Fd. Ntr. 555. Field Work in Nutrition (2-4) Field problems planned to meet needs of individual students. Prerequisite: Fd. Ntr. 450. Hours and problems to be arranged.

Fd. Ntr. 556. The Survey Method in Foods and Nutrition (2) A study of survey technique as a tool in the assay of food adequacy and nutritional status. Lecture 1 hour, recitation 1 hour. *Professor M. L. Dodds*

Fd. Ntr. 557. Interrelationships of Nutrients (2) Interrelationships of nutrients in metabolic processes, their significance as applied to nutrition and in terms of the contribution of food stuffs. Prerequisites: Fd. Ntr. 450, Agr. Biochem. 437. Lecture 1 hour, recitation 1 hour.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fd. Ntr. 420. Experimental Cookery (1-6) *Professor G. M. Olson*
Fd. Ntr. 421. Advanced Foods (3) *Professor Tatiana Levcowich*
Fd. Ntr. 425. Food Preservation (1-2)
Fd. Ntr. 426. Recent Developments in Foods (3)
Fd. Ntr. 450. Nutrition (4) *Professors Ina Padgett, R. L. Pike*
Fd. Ntr. 451. Family Nutrition (3) *Professor Ina Padgett*
Fd. Ntr. 452. Elements of Diet in Disease (3) *Professor R. L. Pike*
Fd. Ntr. 453. Diet Therapy (3) *Professor Ina Padgett*
Fd. Ntr. 455. Teaching Nutrition to Boys and Girls (3)
Fd. Ntr. 491, 491v. Teaching Home Nursing (1)

FORESTRY

Professor Victor A. Beede, M.F.
Head of the Department

For. 500. National and State Administration (3-5) Comparison of the policy and administration of the national forests with the forests of other countries and of the different states. Lecture 1 hour, practicum 5 to 10 hours.
Professor V. A. Beede

For. 502. Wood Fibers (3-5) Identification and physical and chemical characteristics of wood fibers used for pulp, either for paper or as a source of cellulose. Pulping quality, fiber measurements. Lecture and practicum.
Professor W. E. White

For. 504. Research Methods in Forestry (2-6 per semester) Review of methods employed in conducting forestry research. Recitation, conferences, practicum.
Professor W. C. Bramble

For. 508. Forest Ecology (2-4) The organization, development, and classification of forest communities. *Professor W. C. Bramble*

For. 509. Covert Management (2) Management of forest associations for maintenance and development of wildlife. Prerequisite: For. 508.
Professor W. C. Bramble

For. 510. Seminar (1-2 per semester) Current problems of forest research presented as weekly seminar reports. May be repeated with additional credit for each semester's work. *Professor W. C. Bramble*

For. 530. Research in Wood Utilization (3-6 per semester) Research in some chosen phase of wood utilization or forest products. Prerequisite: For. 431. Lecture and practicum hours to be arranged. *Professor N. A. Norton*

For. 531. Structural Uses of Wood and Wood Products (3-6 per semester) Wood as a construction material; testing techniques for structural timbers and wood assemblies; use of laminated wood, ring connectors, and other types of special construction. Prerequisite: For. 404. Lecture and practicum hours to be arranged. *Professor N. A. Norton*

For. 532. Laminates (3-6 per semester) Advanced and special studies in the fabrication and use of plywood, laminated wood, paper-base laminates, and wood-to-metal bonding. Prerequisite: For. 405. Lecture and practicum hours to be arranged. *Professor N. A. Norton*

For. 535. Conditioning Treatments for Wood (3-6 per semester) Advanced study and problems in preservative, seasoning, and other special treatments for wood and wood products. Prerequisite: For. 435. Lecture and practicum hours to be arranged. *Professor N. A. Norton*

For. 550. Forest Mensuration (2-8 per semester) Research in some chosen field. Prerequisite: For. 450. Lecture, conferences, practicum. *Professor H. A. Meyer*

For. 560. Forest Management (3-8) Special topics in forest management and research in some chosen field. Prerequisite: For. 466. Hours to be arranged. *Professor H. A. Meyer*

For. 575. Applications of Forest Economics and Finance (3 per semester) Survey of situations in forestry where business problems and particular circumstances of production, value, and costs are currently significant. Prerequisite: For. 70. Hours to be arranged. *Professor M. W. Humphrey*

For. 590. The Lumber Industry (2-4) The relation of the lumber industry to national economy and world trade; lumbermen's associations; lumber accounts. Prerequisite: For. 430. Lecture 2 to 4 hours.

For. 591. Problems in Lumbering (2-6) Research in some chosen phase of lumbering. Prerequisite or concurrent: For. 590. Lecture and practicum hours to be arranged.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

For. 400.	Advanced Silviculture (2)	*Professor W. C. Bramble*
For. 402.	Forest Research (2)	*Professor W. C. Bramble*
For. 404.	Mechanical Properties of Wood (3)	*Professor N. A. Norton*
For. 405.	Veneer and Plywood (3)	*Professor N. A. Norton*
For. 406.	Forestry Literature (1)	*Professor W. E. White*
For. 417.	National and State Forest Practice (2)	*Professor V. A. Beede*
For. 421.	Regional Silviculture (4)	*Professor H. N. Cope*
For. 427.	Forest Uses (3)	*Professor W. C. Bramble*
For. 430.	Forest Products and Industries (3)	*Professor N. A. Norton*

FOR. 431. ADVANCED UTILIZATION (2-4) *Professor N. A. Norton*
FOR. 435. SEASONING AND PRESERVATION (3) *Professor N. A. Norton*
FOR. 445. IMPROVEMENTS (3)
FOR. 446. FOREST PARK ADMINISTRATION (3)
FOR. 450. ADVANCED MENSURATION (2) *Professor H. A. Meyer*
FOR. 451. STATISTICS IN FORESTRY AND WOOD UTILIZATION (3) *Professor H. A. Meyer*
FOR. 455. AERIAL PHOTOGRAMMETRY IN FOREST MANAGEMENT (2)
FOR. 462. ADVANCED WOOD TECHNOLOGY (2) *Professor W. E. White*
FOR. 466. FOREST MANAGEMENT AND MANAGEMENT PLANS (4) *Professor H. A. Meyer*
FOR. 468. SILVICULTURAL RESEARCH (2-4) *Professor W. C. Bramble*
FOR. 469. PROBLEMS IN FOREST MANAGEMENT (3) *Professor H. A. Meyer*
FOR. 475. PROBLEMS IN FOREST ECONOMICS AND FINANCE (3) *Professor M. W. Humphrey*
FOR. 480. POLICY AND ADMINISTRATION (3) *Professor V. A. Beede*
FOR. 491. LUMBERING (3)
FOR. 492. LUMBER DISTRIBUTION (3)
FOR. 494. LOGGING (3)
FOR. 495. MILLING (3)
FOR. 497. SMALL SAWMILLS (3)

FRENCH

PROFESSOR ROBERT J. CLEMENTS, M.A., Ph.D.
Head of the Department of Romance Languages

ACADEMIC YEAR

FR. 544. NEO-CLASSICISM IN THE ROMANCE LITERATURES (3) The nature and development of the Neo-classic movement in Italy, France, Spain, and Portugal. Prerequisite: Fr. 40. Lecture 3 hours.

FR. 545. ROMANTICISM IN THE ROMANCE LITERATURES (3) The nature and development of the Romantic movement in Italy, France, Spain, and Portugal. Prerequisite: Fr. 40. Lecture 3 hours.

FR. 546. MEDIEVAL ROMANCE LITERATURES (3) The nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal. Prerequisite: Fr. 40. Lecture 3 hours.

FR. 547. REALISM, WITH PARTICULAR REFERENCE TO ROMANCE LITERATURES (3) Prerequisite: Fr. 4. Lecture 3 hours.

FR. 548. 20TH CENTURY ROMANCE LITERATURE AS A POLITICAL FORCE (3) Prerequisite: Fr. 4. Lecture 3 hours.

FR. 551. ROMANCE PHILOLOGY (3) Historical development of the Romance languages. Recitation 3 hours.

Fr. 552. Old and Middle French Readings and Literature (3) Familiarizes the student with Old and Middle French texts from the earliest monument to Villon. Prerequisite: Fr. 551. Recitation 3 hours.

Fr. 553. French Literature of the Renaissance (3) The French Renaissance from 1498 to 1548. Lectures, discussions, and reports. Recitation 3 hours.

Fr. 554. French Literature of the Renaissance (3) The French Renaissance from 1548 to 1594. Lectures, discussions, and reports. Recitation 3 hours.

Fr. 557. French Romantic Poetry (3)

Fr. 562. French Thinkers of the 18th Century (3) Recitation 3 hours.

Fr. 564. French Romanticism (3) The French Romantic Movement after 1830. Lectures, discussions, and reports. Recitation 3 hours.

Fr. 570. Voltaire and Rousseau (3)

Fr. 571. Seminar in French Literature (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor. Recitation 3 hours.

Fr. 572. Seminar in French Literature (3) Continuation of Fr. 571. Recitation 3 hours.

Fr. 573. Research in French Literature (3) In addition to the regular courses there will be an opportunity for students adequately prepared to earn from 1 to 3 credits through research.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fr. 400. French Literature of the 16th Century (3)
Fr. 401. French Theater of the Classical Period (3)
Fr. 402. French Theater of the Classical Period (3)
Fr. 403. French Dramatic Literature of the 18th Century (3)
Fr. 405. French Literature of the 19th Century (3)
Fr. 406. French Literature of the 19th Century (3)
Fr. 407. French Novel of the 19th Century (3)
Fr. 408. French Novel of the 19th Century (3)
Fr. 410. French Contemporary Poetry (3)
Fr. 411. French Literature of the 20th Century (3)
Fr. 413, 413X. Contemporary French Drama (3)
Fr. 414. Contemporary French Drama (3)
Fr. 415. French Novel of the 18th Century (3)
Fr. 421. The Teaching of Romance Languages (3)
Fr. 425. Professional Translating from French into English (3)
Fr. 496. Literary Criticism in France, Italy, and Spain (3)

MAIN SUMMER SESSION

FR. 505S. THE GREAT WRITERS OF FRANCE: BALZAC (2)
FR. 507S. LA FONTAINE AND HIS TIME (2)
FR. 528S. FRENCH LYRIC POETRY OF THE 19TH CENTURY (2)
FR. 531S. FRENCH NOVELISTS OF THE ROMANTIC SCHOOL (2)
FR. 538S. THE ROMANTIC POETS (2)
FR. 540S. CONTEMPORARY FRENCH DRAMA (2)
FR. 541S. MODERN FRENCH DRAMA (2)
FR. 542S. THE FRENCH SHORT STORY OF THE 19TH CENTURY (2)
FR. 555S. VICTOR HUGO AND HIS TIME (2)
FR. 556S. CHARLES BAUDELAIRE (2)
FR. 557S. FRENCH ROMANTIC POETRY (2)
FR. 559S. FRANCE BETWEEN TWO WARS (2)
FR. 560S. MOLIERE AND THE CLASSICAL COMEDY (2)
FR. 565S. FRENCH LITERATURE OF THE 19TH CENTURY (2)
FR. 566S. CLASSICAL FRENCH LITERATURE (2)
FR. 567S. THE FRENCH NOVEL FROM 1870 TO 1914 (2)
FR. 568S. THE CONTEMPORARY NOVEL (2)
FR. 570S. VOLTAIRE AND ROUSSEAU (2)
FR. 573S. RESEARCH IN FRENCH LITERATURE (1-3)
FR. 575S. ADVANCED PHONETICS (2)
FR. 576S. COMPOSITION AND STYLISTICS (2)
FR. 577S. ADVANCED COMPOSITION AND STYLISTICS (3-6)
FR. 579S. RESEARCH LABORATORY IN PHONETICS (1)
FR. 587S. FRENCH NOVELISTS OF THE 18TH CENTURY (2)
FR. 588S. FRENCH POETRY: FROM BAUDELAIRE TO THE SYMBOLISTS (2)
FR. 591S. FRENCH IN THE SECONDARY SCHOOLS (3)
FR. 592S. FRENCH AND SPANISH IN THE SECONDARY SCHOOLS (3)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

FR. 409S. ADVANCED COURSE IN PRONUNCIATION AND CONVERSATION (2)
FR. 469S. FRENCH CIVILIZATION OF THE 19TH CENTURY (2)
FR. 490S. GRAMMAR AND COMPOSITION (3)
FR. 493S. ELEMENTARY PHONETICS (2)
FR. 495S. ADVANCED COMPOSITION AND SYNTAX (3)
FR. 498S. INTERMEDIATE PHONETICS (2)

FUEL TECHNOLOGY

PROFESSOR C. C. WRIGHT, Ph.D.
Chief of the Division

FUEL T. 501. COAL PETROGRAPHY (2) The microscopic examination of coals for

the determination of coal type and vegetable origin. Prerequisite or concurrent: Fuel T. 503. Practicum 6 hours. *Professor C. R. Kinney*

FUEL T. 502. RESEARCH DATA (3) Methods of obtaining and interpreting research data; designed for the graduate student beginning laboratory research. Prerequisite: Math. 30. Lecture 3 hours. *Professor R. F. Nielsen*

FUEL T. 503. CHEMICAL CONSTITUTION AND SCIENTIFIC CLASSIFICATION OF COAL (3-6) The chemistry of plant constituents in relation to coal and the coalification process; constitution of coal as deduced by chemical methods; scientific classification of coals. Prerequisite: Chem. 31. *Professor C. R. Kinney*

FUEL T. 504. FUEL TECHNOLOGY RESEARCH (1-15 per semester) Original research on preparation, carbonization, processing, utilization, or constitution of fuels. Results of the investigation may be used as the thesis. Prerequisites: Fuel T. 502, 503. *Professor C. C. Wright and Staff*

FUEL T. 505. PHYSICOCHEMICAL PROPERTIES OF COAL, MINERAL MATTER, AND ASH (3) The physical, physicochemical, and use properties of coals, mineral matter, and coal ash; their significance and application in the preparation and use of coals; ash fusibility, clinker formation, and slagging. Prerequisite: Chem. 41. Lecture 3 hours. *Professor J. D. Clendenin*

FUEL T. 506. ADVANCED COMBUSTION (3) Advanced combustion and heat balance calculations, ignition and flame characteristics of fuels; furnace atmospheres; selection of fuels with reference to use and equipment. Prerequisite: Chem. 41. Lecture 3 hours. *Professor C. C. Wright*

FUEL T. 507. ADVANCED THERMAL PROCESSING (3) Pyrolysis of carbon compounds; coal carbonization methods and economics; significance of rank and composition in thermal processing and utilization; metallurgical and gas making coke requirements and properties; process control. Prerequisites: Chem. 35, 41, or Min Prep. 410. Lecture 3 hours. *Professor J. D. Clendenin*

FUEL T. 508. SYNTHESIS OF LIQUID FUELS (3) The chemical nature of liquid fuels, lubricating oils, and hydrocarbons of synthetic processes; preparation of hydrogen and synthesis gas; hydrogenolysis of pure compounds, oils, tars, and coal; theoretical aspects of Fischer-Tropsch and related processes. Prerequisites: Chem. 31, Fuel T. 402. Lecture 3 hours. *Professor H. B. Charmbury*

FUEL T. 509. TECHNOLOGY OF TARS (3) Theories of tar formation; chemical constitution of tars and their physical and chemical properties; methods of separation, refining, and purification; uses of tars and tar products. Coal, oil, and water-gas tars are considered. Prerequisite: Chem. 31. Lecture 3 hours. *Professor T. S. Polansky*

FUEL T. 510. FUEL TECHNOLOGY PROBLEM (1-6 per semester) Special problems in fuel technology. Prerequisite: Fuel T. 503. *Professor C. C. Wright and Staff*

FUEL T. 511. FUEL TECHNOLOGY SEMINAR (1-6) Selected topics from current fuel technology research examined and discussed. Prerequisite: Chem. 35 or 41. *Professor C. C. Wright and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

FUEL T. 400. FUEL TECHNOLOGY RESEARCH AND DESIGN (1-3) *Professor C. C. Wright and Staff*

FUEL T. 401. FUEL GASES AND GASIFICATION (3) *Professors C. C. Wright, H. B. Charmbury*

FUEL T. 402. CHEMICAL PROCESSING OF FUELS (2) *Professor H. B. Charmbury*

FUEL T. 403. ENERGETICS OF FUEL TECHNOLOGY (3) *Professor A. W. Gauger*

FUEL T. 404. FUEL TECHNOLOGY DESIGN (3) *Professor T. S. Spicer*

GENERAL HOME ECONOMICS

PROFESSOR HELEN R. LEBARON, M.S., Ph.D.
Assistant Dean of the School of Home Economics

GEN. H.E. 500. RESEARCH IN HOME ECONOMICS (1-6 per semester) Original studies in the field of student's major interest. Conference and practicum hours to be arranged.

GEN. H.E. 501. THESIS (1-15) Conferences and assignments in connection with the preparation of the required thesis.

GEN. H.E. 516, 516v. METHODS OF RESEARCH IN HOME ECONOMICS (3) Review of problems and techniques of research in home economics. Required of all graduate students in home economics. *Professor H. M. Hatcher*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GEN. H.E. 400, 400v, 400X, 400vX. RECENT FINDINGS IN HOME ECONOMICS (2-3)

GEOGRAPHY

PROFESSOR E. WILLARD MILLER, M.A., Ph.D.
Chief of the Division

GEOG. 503. ADVANCED REGIONAL GEOGRAPHY (3-12) Intensive study at an advanced level of selected regions or sections of the continents. Prerequisite: 12 credits in geography. *Professors E. W. Miller, G. F. Deasy*

GEOG. 504. PHYSICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of physical geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professors E. W. Miller, G. F. Deasy*

GEOG. 505. ECONOMIC GEOGRAPHY SEMINAR (3-12) The literature of some phase of economic geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor E. W. Miller*

GEOG. 506. CULTURAL AND POLITICAL GEOGRAPHY SEMINAR (3-12) The literature of

some phase of cultural and political geography with emphasis on procedures for organizing material for classroom reports and discussions.

GEOG. 510. PHYSICAL GEOGRAPHY RESEARCH (3-10) Original study in some phase of physical geography. This may be a field problem or a problem which requires detailed library investigation together with analysis and presentation of data and statistics. Results of investigation may form basis for thesis.

Professor G. F. Deasy

GEOG. 511. ECONOMIC GEOGRAPHY RESEARCH (3-10) Original study in some phase of economic geography research. This may be a field problem or a problem which requires detailed library investigation together with analysis and presentation of data and statistics. Results of investigation may form basis for thesis.

Professor E. W. Miller

GEOG. 512. CULTURAL AND POLITICAL GEOGRAPHY RESEARCH (3-10) Original study in some phase of cultural and political geography research. This may be a field problem or a problem which requires detailed library investigation together with analysis and presentation of data and statistics. Results of investigation may form basis for thesis.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GEOG. 400.	REGIONAL GEOGRAPHY OF NORTH AMERICA (3)	*Professor G. F. Deasy*
GEOG. 401.	REGIONAL GEOGRAPHY OF PENNSYLVVANIA (3)	*Professor E. W. Miller*
GEOG. 402.	REGIONAL GEOGRAPHY OF MIDDLE AMERICA (3)	*Professor P. R. Griess*
GEOG. 403.	REGIONAL GEOGRAPHY OF SOUTH AMERICA (3)	*Professor P. R. Griess*
GEOG. 405.	CULTURAL GEOGRAPHY (3)	*Professor P. R. Griess*
GEOG. 433.	REGIONAL CLIMATOLOGY (3)	*Professor G. F. Deasy*
GEOG. 435.	FIELD METHODS IN GEOGRAPHY (3)	*Professor E. W. Miller*
GEOG. 442.	GEOGRAPHY OF EUROPE (3)	*Professor E. W. Miller*
GEOG. 443.	GEOGRAPHY OF THE ORIENT (3)	*Professor G. F. Deasy*
GEOG. 444.	GEOGRAPHY OF AFRICA (3)	*Professor P. R. Griess*
GEOG. 445.	GEOGRAPHY OF THE AIR AGE (3)	*Professor E. W. Miller*
GEOG. 452.	INTERPRETATION OF AERIAL PHOTOGRAPHS (3)	*Professor G. F. Deasy*
GEOG. 460.	POLITICAL GEOGRAPHY (3)	*Professor P. R. Griess*
GEOG. 480.	GEOGRAPHY OF WORLD MANUFACTURING (3)	*Professor E. W. Miller*

GEOLOGY

PROFESSOR FRANK M. SWARTZ, Ph.D.
Chief of the Division

*GEOL. 500. GEOLOGY SEMINAR (1-9) Presentation, at weekly departmental meetings, of topics selected from geological literature.

* Credits to be arranged, 1 to 6 per semester.

†Geol. 501. Stratigraphy (3-12) Principles of stratigraphic classification, lithofacies and biofacies, faunal zonation, correlation, sedimentation, and paleogeography, illustrated by stratigraphy of classical geologic regions: (a) Pre-Cambrian; (b) Paleozoic; (c) Mesozoic; (d) Cenozoic. Prerequisite: Geol. 464.
Professor F. M. Swartz

‡Geol. 502. Geological Research (3-18) An original investigation of a geological problem approved by the chief of the division. Results of the investigation may be used for the thesis.

†Geol. 503. Paleontology (3-9) Morphology of animal groups significant for their fossils; nature of species and faunal zones. Seminars may be arranged for studies of special fossil groups, microfossils, paleoecology.
Professor F. M. Swartz

§Geol. 504. History of Geology (2-3) Development through the ages of the scientific method in the earth sciences. *Professor P. D. Krynine*

†Geol. 507. Geomorphology (3-9) Processes involved in the development of land forms; relationships to structural and lithologic features; interpretation of the history of development; principles of description and classification. Prerequisite: Geol. 32.

†Geol. 508. Dynamical Geology (3-6) Dynamics of external earth processes of mass wasting, currents and waves, wind action, ice movements; and of internal processes of diastrophism and vulcanism. Prerequisite: Geol. 483.

†Geol. 509. Volcanology (3-6) Volcanic phenomena, structures, land forms, and great modern eruptions, in relation to dynamics of extrusion, geographic and stratigraphic distribution, classification. Prerequisite: Geol. 32.

†Geol. 511. Ore Deposits: Principles (3-6) Geological and geochemical processes controlling ore deposition; genetic classification of ore deposits. Prerequisite: Geol. 451. *Professor J. D. Ridge*

†Geol. 512. Ore Deposits: Types (3-6) The geologic history of selected ore bodies with respect to forming media; causes, sequences, and loci of emplacement; alteration. Microscopic investigation of ore and rock specimens. Prerequisite: Geol. 451.
Professor J. D. Ridge

†Geol. 513. Ore Deposits: Chemical Prospecting (3-6) Methods of prospecting using techniques of geochemical, biochemical, and hydrochemical analysis. Prerequisites: Chem. 20, Geol. 451. *Professor J. D. Ridge*

†Geol. 520. Paleobotany (3-6) Classification, morphology, nomenclature, and stratigraphic occurrence of fossil plants. Prerequisite: Geol. 32.
Professor W. Spackman, Jr.

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† Credits to be arranged, 3 to 6 per semester.
‡ Credits to be arranged, 3 to 9 per semester.
§ Credits to be arranged, 2 or 3 per semester.

*Geol. 524. Geology of Coal (1-6) Origin, geologic modifications, microscopy of coal; relations to enclosing sediments; geologic and geographic distribution. Prerequisite: Geol. 32 or Chem. 35. *Professor W. Spackman, Jr.*

†Geol. 530. Geological Problems (3-6) Study, from the literature, of a selected geological problem. Prerequisite: 10 credits of geology and mineralogy.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Geol. 451.	Economic Geology (3)	*Professor J. D. Ridge*
Geol. 461.	Physiography of the United States (3)	
Geol. 464.	Paleontology (3)	*Professor F. M. Swartz*
Geol. 481.	Geology of Oil and Gas (3)	
Geol. 482.	Metallic Mineral Deposits (3)	*Professor J. D. Ridge*
Geol. 483.	Structural Geology (3)	*Professor F. M. Swartz*
Geol. 484.	Paleozoic Stratigraphy (3)	*Professor F. M. Swartz*
Geol. 485.	Paleontology (2)	*Professor F. M. Swartz*
Geol. 486.	Stratigraphic Methods (1)	*Professor F. M. Swartz*
Geol. 488.	Earth Sciences Seminar (1)	
Geol. 489.	Earth Sciences Report (1)	

GEOPHYSICS AND GEOCHEMISTRY

Professor B. F. Howell, Jr., M.S., Ph.D.
Chief of the Division

Geophys. 500. Geophysical Seminar (1-3) Discussion of geophysical reports and papers; scientific outlook. Prerequisites: Geophys. 401, 402. Lecture 1 to 3 hours.
Professor B. F. Howell, Jr.

Geophys. 501. Geophysical Research (3-12) Research work in theoretical and applied geophysics; especially the branches of the seismology and geophysical methods of exploration. Practicum 3 hours per credit. *Professor B. F. Howell, Jr.*

Geophys. 502. Selected Chapters of Advanced Geophysics (2) Lecture, review, and discussion of current problems in geophysics; topics not covered in Geophys. 401, such as seismological theory, geological effects of geophysical events. Given alternate years. Prerequisite: Geophys. 401. Lecture 2 hours.
Professor B. F. Howell, Jr.

Geophys. 503. Geophysical Surveys (3-6) An advanced course in the theory of geophysical methods of exploration and interpretation of data. Prerequisites: Geophys. 402, Math. 100. Lecture and practicum 3 to 18 hours.
Professor B. F. Howell, Jr.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

* Credits to be arranged, 1 to 6 per semester.
† Credits to be arranged, 3 to 6 per semester.

GEOPHYS. 401. MINERAL GEOPHYSICAL PROSPECTING (3)
GEOPHYS. 402. PETROLEUM GEOPHYSICAL PROSPECTING (4)
Professor B. F. Howell, Jr.
GEOPHYS. 403. GEOPHYSICS FIELD WORK (3) Summer practicum.
GEOPHYS. 404. GEOPHYSICAL PROSPECTING PROBLEMS (3)
GEOPHYS. 405. INTRODUCTORY GEOPHYSICS (3) *Professor B. F. Howell, Jr.*
GEOPHYS. 406. INTRODUCTORY GEOCHEMISTRY (3) *Professor B. F. Howell, Jr.*

GERMAN

PROFESSOR PHILIP A. SHELLEY, A.M., Ph.D.
Head of the Department

GER. 501. GERMAN LANGUAGE SEMINAR (3-9) Critical study of special problems in the Germanic languages, with emphasis on Gothic and the High German dialects in different eras. Papers.

GER. 515. GERMAN LITERATURE SEMINAR (3-9) Special aspects and characteristics of individual writers and various types and periods of literature.

GER. 524. INTENSIVE STUDY OF THE LIFE AND WORKS OF GOETHE (3) Various phases of the poet's life and individual works. Recitation 3 hours.
Professor A. F. Buffington

GER. 531. SPECIAL STUDIES IN THE GERMAN LYRIC (3) *Professor P. A. Shelley*

GER. 532. SPECIAL STUDIES IN THE GERMAN DRAMA (3) *Professor Helen Adolf*

GER. 533. SPECIAL STUDIES IN THE GERMAN SHORT STORY (3)
Professor Herbert Steiner

GER. 534. SPECIAL STUDIES IN THE GERMAN NOVEL (3) *Professor Helen Adolf*

GER. 551. MIDDLE HIGH GERMAN (3) Extensive reading of texts; characteristics of the various dialects. Recitation 3 hours. *Professor A. F. Buffington*

GER. 552. OLD HIGH GERMAN (3) Essentials of the grammar, with special treatment of the High German sound shift and of ablaut and umlaut. Reading of works written before 1100 A. D. Papers. Recitation 3 hours. *Professor A. F. Buffington*

GER. 553. GOTHIC (3) Essentials of the grammar; reading of Ulfilas' Bible translation. Suitable also for advanced students in English. Papers. Recitation 3 hours.
Professor Helen Adolf

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

GER. 400. PROSEMINAR IN BIBLIOGRAPHY AND METHODS OF RESEARCH (2)
Professor P. A. Shelley
GER. 401. HISTORY OF THE GERMAN LANGUAGE (3) *Professor A. F. Buffington*

GER. 421. GERMAN LITERATURE IN THE 18TH CENTURY (3)
Professor A. F. Buffington

GER. 422. GERMAN LITERATURE IN THE 19TH CENTURY (3) *Professor Helen Adolf*

GER. 423. GERMAN LITERATURE OF THE 20TH CENTURY (3)
Professor Herbert Steiner

GER. 443. LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3-9)
Professor P. A. Shelley

GREEK

PROFESSOR ROBERT E. DENGLER, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

GREEK 500. GREEK COMPOSITION (2) Translation of extended narrative passages into Attic Greek; a thorough review of forms and syntax; attention to the rhetorical elements of the language. Recitation 2 hours. *Professor R. E. Dengler*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

GREEK 411S. ESSENTIALS OF GREEK (3)

GREEK 421. GREEK TRAGEDY (3) *Professor R. E. Dengler*

GREEK 422. GREEK COMEDY (3) *Professor R. E. Dengler*

GREEK 423. ATTIC ORATORS (3) *Professor R. E. Dengler*

GREEK 424. GREEK HISTORY OR PHILOSOPHY (3) *Professor R. E. Dengler*

GREEK 427. NEW TESTAMENT GREEK (3) *Professor R. E. Dengler*

HEALTH EDUCATION

Consult PROFESSOR ARTHUR L. HARNETT, JR., M.A., Ed.D.

HEALTH ED. 501. HEALTH IMPLICATIONS IN THE GROWTH AND DEVELOPMENT OF SCHOOL CHILDREN (3) Child growth and development emphasis for teachers; medical inspection and examination; preschool program; early habit formations; behavior problems; co-operation of parents, teachers, and children. Prerequisite: Health Ed. 215. *Professor A. F. Davis*

HEALTH ED. 505. ADVANCED TECHNIQUES IN HEALTH EDUCATION (3) Prerequisites: Health Ed. 215, 399, Psy. 437. *Professor A. F. Davis*

HEALTH ED. 572. TESTS AND MEASUREMENTS IN HEALTH EDUCATION (3) Critical study, evaluation, and demonstration of tests and measures of health education; statistical computations of data. Prerequisites: Phys. Ed. 490, Health Ed. 215, 399. *Professor A. L. Harnett, Jr.*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HEALTH ED. 403. FIRST AID, ATHLETIC CONDITIONING AND TRAINING (3) *Professor S. P. Fogg*

HEALTH ED. 405. RECENT DEVELOPMENTS IN PUBLIC HEALTH EDUCATION (3-6) *Professor A. F. Davis*

HEALTH ED. 406. RECENT DEVELOPMENTS IN SCHOOL HEALTH EDUCATION (3) *Professor A. F. Davis*

HEALTH ED. 407, 407X. ADVANCED PERSONAL AND PUBLIC HEALTH (3) *Professor A. F. Davis*

HEALTH ED. 411, 411X. SAFETY EDUCATION IN THE SCHOOLS (3) *Professor C. D. Werner*

HEALTH ED. 427. HEALTH FACTORS IN THE DEVELOPMENT OF THE ADOLESCENT (3) *Professor A. F. Davis*

HEALTH ED. 453, 453X. ORGANIZATION AND ADMINISTRATION OF HEALTH EDUCATION (3) *Professor A. L. Harnett, Jr.*

HEALTH ED. 455S. RELATIONSHIPS OF HEALTH EDUCATION TO THE EXACT SCIENCES (3) *Professor A. L. Harnett, Jr.*

HEALTH ED. 456. ADVANCED TECHNIQUES IN RURAL SCHOOL HEALTH (3) *Professor A. F. Davis*

HISTORY

PROFESSOR J. PAUL SELSAM, M.A., Ph.D.
Head of the Department

HIST. 500. SEMINAR IN AMERICAN HISTORY (3-6) Subject to be announced. *Professors W. H. Gray, B. M. Hermann, P. S. Klein*

HIST. 501. EUROPEAN HISTORIOGRAPHY (3) *Professor A. G. Pundt*

HIST. 502. AMERICAN HISTORIOGRAPHY (3) *Professor P. S. Klein*

HIST. 506. THE DIPLOMATIC BACKGROUND OF THE WORLD WAR, 1871 TO 1914 (3) Prerequisites: Hist. 18, 19. *Professors J. E. Gillespie, J. P. Selsam*

HIST. 507. THE REFORM MOVEMENT IN MODERN ENGLAND, 1832 TO THE PRESENT (3) *Professors J. E. Gillespie, A. G. Pundt*

HIST. 508. STUDIES IN EUROPEAN HISTORY, 1600-1789 (3) *Professor J. P. Selsam*

HIST. 509. THE FRENCH REVOLUTION AND NAPOLEONIC ERA, 1789-1815 (3) Prerequisites: Hist. 18, 19. *Professors J. E. Gillespie, J. P. Selsam*

HIST. 511. SEMINAR IN EUROPEAN HISTORY (3-6) *Professors J. E. Gillespie, J. P. Selsam, A. G. Pundt*

HIST. 512. STUDIES IN PENNSYLVANIA HISTORY (3-6) *Professor P. S. Klein*

HIST. 515. STUDIES IN SOUTHERN HISTORY (3) *Professor P. S. Klein*

HIST. 520. THE AMERICAN REVOLUTION, 1763-1783 (3) Prerequisites: Hist. 20, 21. *Professor B. M. Hermann*

HIST. 529. CULTURAL HISTORY OF THE EARLY MIDDLE AGES (3) *Professor J. H. Dahmus*

HIST. 532. STUDIES IN MEDIEVAL CIVILIZATION (3) *Professor J. H. Dahmus*

HIST. 533. STUDIES IN HISTORY OF THE UNITED STATES, 1829-1860 (3) *Professor P. S. Klein*

HIST. 534. THE CIVIL WAR AND RECONSTRUCTION, 1860-1877 (3) Prerequisites: Hist. 20, 21. Recitation 3 hours. *Professors P. S. Klein, B. M. Hermann*

HIST. 536. STUDIES IN THE HISTORY OF THE UNITED STATES, 1877-1900 (3)

HIST. 538. STUDIES IN THE HISTORY OF FOREIGN RELATIONS OF THE UNITED STATES, 1942 TO THE PRESENT (3)

HIST. 562. SEMINAR IN LATIN-AMERICAN HISTORY (3-6) Prerequisites: Hist. 22, 23. *Professor W. H. Gray*

HIST. 563. STUDIES IN THE HISTORY OF THE CARIBBEAN AREA (3) Prerequisites: Hist. 22, 23. Lecture 3 hours. *Professor W. H. Gray*

HIST. 564. MEXICO IN THE 20TH CENTURY (3) Prerequisites: Hist. 22, 23. Lecture 3 hours. *Professor W. H. Gray*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HIST. 405. HISTORICAL BACKGROUND OF AMERICAN POLITICAL PARTIES, 1607-1900 (3) *Professor J. G. Rayback*

HIST. 406. HISTORY OF AMERICAN LABOR (3) *Professor J. G. Rayback*

HIST. 418. RENAISSANCE AND REFORMATION (3) *Professors J. E. Gillespie, J. P. Selsam*

HIST. 419, 419X. RECENT EUROPEAN HISTORY (3) *Professors J. E. Gillespie, K. Forster*

HIST. 421, 421X. RECENT AMERICAN HISTORY (3) *Professors B. M. Hermann, K. Forster*

HIST. 423. THE FORMATIVE PERIOD OF AMERICAN HISTORY (3) *Professor P. S. Klein*

HIST. 437. THE MIDDLE AGES FROM CONSTANTINE TO THE CRUSADES (3) *Professor J. H. Dahmus*

HIST. 438. THE MIDDLE AGES FROM THE CRUSADES TO THE RENAISSANCE (3) *Professor J. H. Dahmus*

HIST. 441. RECENT HISTORY OF GREAT BRITAIN (3) *Professor A. G. Pundt*

HIST. 443. HISTORY OF MODERN RUSSIA (3) *Professor J. P. Selsam*

HIST. 444. EASTERN EUROPE IN MODERN TIMES (3) *Professor J. P. Selsam*

HIST. 446. THE DEVELOPMENT OF THE BRITISH EMPIRE (3) *Professor J. E. Gillespie*

HIST. 447. ECONOMIC DEVELOPMENT OF MODERN EUROPE SINCE 1750 (3) *Professor A. G. Pundt*

HIST. 448. SOCIAL AND CULTURAL HISTORY OF MODERN EUROPE (3)
Professor J. P. Selsam

HIST. 450. ECONOMIC DEVELOPMENT OF COLONIAL AMERICA, 1607-1783 (3) To alternate with Hist. 451. *Professor B. M. Hermann*

HIST. 451. SOCIAL AND CULTURAL HISTORY OF COLONIAL AMERICA, 1607-1783 (3) To alternate with Hist. 450. *Professor B. M. Hermann*

HIST. 452. SOCIAL AND CULTURAL HISTORY OF THE UNITED STATES SINCE 1783 (3)
Dr. I. V. Brown

HIST. 453. AMERICAN POLITICAL BIOGRAPHY (3) *Professor B. M. Hermann*

HIST. 454. THE ECONOMIC DEVELOPMENT OF THE UNITED STATES IN THE 19TH CENTURY (3) *Dr. N. A. McNall*

HIST. 460. LATIN AMERICA AND THE UNITED STATES (3) *Professor W. H. Gray*

HIST. 461. SOCIAL AND CULTURAL HISTORY OF LATIN AMERICA (3) To alternate with Hist. 460. *Professor W. H. Gray*

HOME ART

PROFESSOR AMY G. GARDNER, M.A.
Chairman of the Division

H. ART 515. BACKGROUNDS OF THE HOME ARTS (3) Art quality in the useful objects of today and of the past; comparison and evaluation of their form and function for the needs of their time; selections from industry and from hand arts leading to an exhibition. Prerequisites: Art 54 or Art Ed. 6, Art 74 or H. Art 240. Lecture 2 hours, practicum 2 hours. *Professor A. G. Gardner*

H. ART 541. ART IN THE ENVIRONMENT (3) Approach based upon human needs with consideration of materials in the light of their use in home living. Prerequisite: Art 76 or Art Ed. 5 or H. Art 440. Lecture 2 hours, practicum 2 hours.
Professor A. G. Gardner

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

H. ART 433, 433X. ADVANCED HOME CRAFTS (2-12)
H. ART 434. THE ART AND THE CRAFTS IN THE HOMEMAKING PROGRAM (3-6)
H. ART 440, 440X. HOME FURNISHING PROBLEMS (3)
H. ART 443. HOME ARTS IN THE ADULT PROGRAM (3)
H. ART 444, 444X. HOME FURNISHING TEACHING PROBLEMS (3)
H. ART 447, 447X. HOME FURNISHINGS FOR THE FAMILY (3)

HOME-COMMUNITY RELATIONSHIPS

PROFESSOR HELEN R. LEBARON, M.S., Ph.D.
Chairman of the Division

H.C. REL. 502, 502v, 502X, 502vX. HOME ECONOMICS AND AMERICAN SOCIETY (3)

Family life education in relation to a democratic culture; emphasis upon the interrelatedness of socioeconomic problems and the American family.

H.C. Rel. 503. Graduate Seminar in Home Economics (1) Prerequisite: graduate standing. Discussion 1 hour. *Professor G. M. Henderson*

HOME ECONOMICS EDUCATION

Professor Jean D. Amberson, M.A., Ph.D.
Head of the Department

H.E. Ed. 500, 500v. Research in Home Economics Education (1-6) Investigation in home economics education. Individual conferences on research.
Professor J. D. Amberson or H. M. Hatcher

H.E. Ed. 505, 505v, 505X, 505vX. Practicum in Teaching Home Economics in the Secondary School (3-6) Projects in home economics education which may be carried out in the school in which the teacher is regularly employed. Conference and practicum hours to be arranged. *Professor J. D. Amberson*

H.E. Ed. 506, 506v, 506X, 506vX. Current Developments in Education in Relation to Home Economics (3) Opportunity for home economists to study newer developments in education. Prerequisite: one year of teaching experience in home economics. Lecture 3 hours. *Professor J. D. Amberson*

H.E. Ed. 509, 509v, 509X, 509vX. Curriculum Workshop in Family Life Education (3) Laboratory course in problems of curriculum building; individual problems in this field; frequent individual and group conferences. Prerequisite: one year's experience in teaching home economics.
Professor J. D. Amberson or H. M. Hatcher

H.E. Ed. 510, 510v, 510X, 510vX. The Supervision of Home Economics Teaching (2-6) For teachers of home economics desiring to qualify as city, county, or student teacher supervisors. Prerequisite: graduation from four-year teacher training curriculum and two years' teaching experience in home economics.
Professor J. D. Amberson, H. M. Hatcher, or M. E. Riegel

H.E. Ed. 518, 518v, 518X, 518vX. Evaluation in Family Life Education (3) Methods of evaluating progress toward goals in home economics education and the use of findings in program planning and revision. *Professor H. M. Hatcher*

H.E. Ed. 521, 521v, 521X, 521vX. Home Economics Education Seminar (2-3) Selected topics and recent developments in education for family living. Conferences and guidance relative to individual research problems.
Professor J. D. Amberson or H. M. Hatcher

H.E. Ed. 526, 526v, 526X, 526vX. The Community Program in Family Life Education (2-3) Ways of discovering community needs and resources; methods in developing the community program in family living; leadership education for the lay member of the community. Recitation 2 or 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

H.E. Ed. 406, 406v, 406X, 406vX. Teaching Aids in Family Life Education (1-4) *Professor M. E. Riegel*

H.E. Ed. 415v, 415vX. The Teaching of Homemaking (2)

H.E. Ed. 416v, 416vX. Administering the Homemaking Program (2)

H.E. Ed. 427, 427v, 427X, 427vX. Family Life Education (3)

H.E. Ed. 443, 443v, 443X, 443vX. Adult Homemaking Education (3) *Professor R. H. Cook*

H.E. Ed. 463, 463v. Senior Seminar (1)

H.E. Ed. 466, 466v. Student Teaching (9)

H.E. Ed. 478, 478v, 478X, 478vX. Appraising Student Progress in Education for Family Living (3)

HORTICULTURE

Professor Warren B. Mack, M.S., Ph.D., Sc.D., A.N.A.
Head of the Department

Hort. 500. Ecology of Fruit Plants (3) The factors limiting the distribution and intensity of culture of fruit species and varieties and the effect of environmental factors on cultural practices. Conference 3 hours.

Hort. 501. Pomology Research (2-12) Investigation of problems involving review of literature, field and laboratory research. Prerequisite or concurrent: Hort. 445. *Professor D. G. White*

Hort. 503. Experimental Plant Breeding (3-6) Problems based mainly on the research work of the department, with a review of experimental methods and literature. Prerequisite: Hort. 444. *Professor R. E. Larson*

Hort. 504. Vegetable Crop Research (2-9) Investigation of problems involving review of literature, field and laboratory research. Prerequisite: Hort. 420 or 424. *Professor M. L. Odland*

Hort. 505. Problems in Vegetable Production (2-6) Methods used in the more valuable contributions to vegetable production. Prerequisite: Hort. 420 or 424. *Professor M. L. Odland*

Hort. 506. Nutrition of Horticultural Crops (2-4) Principles, applications, and interpretations of diagnostic methods for determining fertilizer requirements of horticultural crops. *Professor Walter Thomas*

Hort. 507. Plant Breeding Research (3-6) A critical review of the breeding projects of the department, with original investigations. Prerequisite: Hort. 444. *Professor R. E. Larson*

Hort. 512. Principles of Fruit and Vegetable Storage (2-4) Principles involved in the maturation, storage, and senescence of fruits and vegetables, and their application. *Professor W. B. Mack*

HORT. 513. RESEARCH IN ORNAMENTAL HORTICULTURE (2-12) Review of research in ornamental horticulture, with original investigations.
Professor R. P. Meahl

HORT. 514. PROPAGATION OF ORNAMENTAL AND FRUIT PLANTS (3) Factors affecting the asexual and sexual propagation of fruit and ornamental plants.
Professor R. P. Meahl

HORT. 515. ECOLOGY OF ORNAMENTAL PLANTS (3) The interrelation of ornamental plants and their environments, with emphasis on autecology.

HORT. 517. HORTICULTURE SEMINAR (1 per semester) Review of current research publications in horticulture. Each student presents one or more reviews of assigned topics. Conference 1 hour weekly.

HORT. 518. RESEARCH PROBLEMS IN LANDSCAPE HORTICULTURE (2-12) Selected problems to be assigned for original investigation in the creation, conservation, or management of planted areas. Prerequisite: Hort. 455. Practicum 6 to 36 hours.
Professor J. R. Bracken

HORT. 519. SEMINAR ON THE GENETICS OF HORTICULTURAL CROPS (1 per semester) Review of current research publications on the genetics of horticultural crops. Each student presents one or more reviews of literature on assigned topics. Conference 1 hour weekly.

HORT. 520. SEMINAR ON THE BREEDING OF HORTICULTURAL CROPS (1 per semester) Each student presents one or more reviews of literature on assigned topics. Conference 1 hour weekly.

HORT. 521. TECHNICAL PRACTICES IN LANDSCAPE CONTRACTING (2-12) Commercial and technical operations in landscape contracting and maintenance services. Prerequisites: Hort. 460, 461. Practicum 6 to 36 hours. *Professor J. R. Bracken*

HORT. 523. PROPAGATION AND IMPROVEMENT OF VEGETABLE AND FLOWER CROPS (3) Methods and special techniques in breeding of flowers and vegetables; maintenance of seed stocks and seed production. Prerequisite: Hort. 444 or Bot. 423.
Professor M. L. Odland

HORT. 524. EXPERIMENTAL PROCEDURES IN HORTICULTURAL RESEARCH (3)
Professor R. E. Larson

HORT. 525. HORTICULTURAL RESEARCH TECHNIQUES (3) Practice in and comparison of methods and apparatus used in horticultural research.
Professor D. G. White

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HORT. 418. SUBTROPICAL AND TROPICAL FRUITS (3) *Professor D. G. White*
HORT. 420. ADVANCED COMMERCIAL VEGETABLE PRODUCTION (3)
Professor M. L. Odland
HORT. 423. ADVANCED FRUIT AND VEGETABLE PROCESSING (3)

HORT. 424. ADVANCED OLERICULTURE (3-6) *Professor M. L. Odland*
HORT. 427. ADVANCED FLORICULTURE (3)
HORT. 428. ADVANCED FLORICULTURE (3)
HORT. 444. ADVANCED PLANT BREEDING (3-6) *Professor R. E. Larson*
HORT. 445. PRINCIPLES OF POMOLOGY (3) *Professor D. G. White*
HORT. 446. ADVANCED POMOLOGY (3) *Professor D. G. White*
HORT. 447. PROBLEMS IN POMOLOGY (1-3) *Professor D. G. White*
HORT. 453. NURSERY PRINCIPLES AND PRACTICE (3) *Professor R. P. Meahl*
HORT. 454. LANDSCAPE PROBLEMS (3-6) *Professor J. R. Bracken*
HORT. 455. LANDSCAPE PROBLEMS (3-6) *Professor J. R. Bracken*
HORT. 456. PROBLEMS IN NURSERY PRACTICE (3) *Professor R. P. Meahl*
HORT. 460. LANDSCAPE HORTICULTURE PROJECTS (3) *Professor J. R. Bracken*
HORT. 461. PARKS AND PARK ADMINISTRATION (3) *Professor J. R. Bracken*
HORT. 462. INSTITUTIONAL GROUNDS AND THEIR ADMINISTRATION (3) *Professor J. R. Bracken*
HORT. 463. LANDSCAPE HORTICULTURE PROJECTS (1-6) *Professor J. R. Bracken*

HOTEL ADMINISTRATION

PROFESSOR ESTHER A. ATKINSON, M.S.
Head of the Department of Hotel and Institution Administration

The following courses may be taken for graduate credit under the restrictions in force:

HL. ADM. 415. HOTEL PROMOTION (2) *Professor R. M. Bower*
HL. ADM. 440. HOTEL OPERATIONAL LIABILITIES (2) *Professor R. M. Bower*
HL. ADM. 445. HOTEL ORGANIZATION AND OPERATION (3) *Professor R. M. Bower*

HOUSING AND HOME EQUIPMENT

PROFESSOR DELPHA E. WIESENDANGER, M.S.
Acting Head of the Department of Home Management, Housing, and Art

The following course may be taken for graduate credit under the restrictions in force:

HS. EQP. 470, 470X. HOUSING THE FAMILY (2-3) *Professor D. E. Wiesendanger*

INDUSTRIAL ARTS

PROFESSOR S. LEWIS LAND, M.S., Ph.D.
Head of the Department of Industrial Education
PROFESSOR JOHN F. FRIESE, M.S.

IND. ARTS 574. HISTORY AND PHILOSOPHY OF INDUSTRIAL ARTS (2-3) Historical developments and concurrent educational philosophies of industrial arts in Ameri-

can education. Prerequisite: 12 hours in professional courses in industrial arts education or teaching experience. Lecture 2 or 3 hours.

IND. ARTS 575. PROBLEMS IN INDUSTRIAL ARTS EDUCATION (2-3) Subject matter, projects, methods of manual and informational teaching, aids and devices, selection of text and reference materials, personnel organization, shop management, problem pupils. Prerequisite: 12 hours of industrial arts education.

IND. ARTS 576. SUPERVISION AND ADMINISTRATION OF INDUSTRIAL ARTS EDUCATION (2-3) How to organize, supervise, and administer functioning programs of industrial arts; the duties of a supervisor and director of industrial arts. Lecture 2 or 3 hours.

IND. ARTS 577. TESTING IN INDUSTRIAL ARTS (2-3) Construction of informal manipulative and written tests; use of standardized mechanical aptitude and achievement tests; construction and use of rating scales; scoring and grading; interpretation of test results. Prerequisites: 6 hours in graduate courses in industrial arts and a graduate course in psychology. Lecture 2 or 3 hours.

IND. ARTS 578. RESEARCH IN INDUSTRIAL ARTS (1-18) Individual research in industrial arts for dissertations and lesser research studies. Prerequisite: 6 hours in professional courses in industrial arts.
Unit A. Common Research Techniques in Industrial Arts (2-3)
Unit B. Individual Research Problems in Industrial Arts (1-15)

IND. ARTS 579. MASTER'S THESIS IN INDUSTRIAL ARTS (1-6) Conferences and assignments relating to the preparation of an acceptable thesis for the Master of Science or Master of Education degrees. Prerequisite: 6 hours in professional courses in industrial arts.

IND. ARTS 580. SEMINAR IN INDUSTRIAL ARTS (2-9) Directed intensive study, investigation, or research in selected phases of the program; reports and constructive criticism. Prerequisite: 12 hours in industrial arts education or teaching experience. Lecture 2 to 9 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

IND. ARTS 407, 407X. INDUSTRIAL ARTS EDUCATION (2-3)
IND. ARTS 421, 421X. CURRICULUM MATERIALS IN INDUSTRIAL ARTS (2-3)
IND. ARTS 470, 470X. PROBLEMS IN SENIOR HIGH SCHOOL INDUSTRIAL ARTS (2-3)

INDUSTRIAL EDUCATION

PROFESSOR S. LEWIS LAND, M.S., Ph.D.
Head of the Department

IND. ED. 501v. SEMINAR IN VOCATIONAL EDUCATION (1-12) Conferences, investigations, and discussion for advanced students and mature persons who have had experience as teachers, supervisors, or administrators. Conference 1 to 12 hours.

Unit A. Curriculum Construction (2-3)
Unit B. Testing and Grading (2-3)
Unit C. Vocational Technical Education (2-3)
Unit D. Adult Education (2-3)

IND. ED. 506v. ADMINISTRATION OF VOCATIONAL EDUCATION (1-6) The job of the local director of industrial education in organizing and developing city and other local programs of industrial education. Prerequisite: 6 semester hours in industrial education or valid director's certificate, equivalent training and experience. Lecture 1 to 6 hours.

IND. ED. 510v. VOCATIONAL EDUCATION FOR ADMINISTRATORS (2-3) Designed for school administrators and supervisors who desire an understanding of practical arts and vocational education. Prerequisite: Ind. Ed. 1v or trade or teaching experience. Lecture 2 or 3 hours.

IND. ED. 550v. RESEARCH IN VOCATIONAL EDUCATION (1-12) Research techniques in vocational education and research problems in connection with work of evening, part-time, or day vocational industrial schools.
Unit A. Research Techniques in Vocational Industrial Education (2-3)
Unit B. Individual Research Problems in Vocational Industrial Education (1-10)

IND. ED. 555v. CURRENT PROBLEMS IN VOCATIONAL EDUCATION (1-6) Recent trends and developments in part-time, full-time, and evening school education, involving critical analysis of objectives, content, and outcome. Lecture 1 to 6 hours.
Unit A. Changing Industrial, Economic, and Social Conditions (1)
Unit B. Policies and Program of the American Vocational Association (1)
Unit C. Federal and State Vocational Legislation, Present and Pending (1)
Unit D. Financing Vocational Education (1)
Unit E. Current Administrative Problems in Vocational Education (1)
Unit F. Current Administrative Problems in Vocational Education (continued) (1)

IND. ED. 558v. FRONTIER PROBLEMS IN VOCATIONAL INDUSTRIAL EDUCATION (2-3 per unit)
Unit A. Federal Legislation (2-3)
Unit B. Present-Day Local Personnel and Curriculum Problems (2-3)
Unit C. State and Local Supervision and Administration (2-3)

IND. ED. 560v. PHILOSOPHY OF INDUSTRIAL EDUCATION (2-3) Principles and beliefs upon which progressive industrial education rests; basic concepts underlying practical arts and vocational education; literature for evaluating instructional practices. Prerequisite: 12 hours in industrial education or teaching experience. Lecture 2 or 3 hours.

IND. ED. 590v. MASTER'S THESIS IN INDUSTRIAL EDUCATION (2-6) Conferences and assignments relating to the selection and preparation of an acceptable thesis for the degree of Master of Education or Master of Science.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

IND. ED. 401v, 401vX. HISTORY OF INDUSTRIAL EDUCATION (2-3)
IND. ED. 402v, 402vX. SUPERVISION OF VOCATIONAL EDUCATION (2-3)
IND. ED. 403v, 403vX. SUPERVISED FIELD WORK (1-6)
IND. ED. 405v, 405vX. CONFERENCE LEADER TRAINING (2-3)
IND. ED. 408v, 408vX. OCCUPATIONS (2-3)
IND. ED. 409v, 409vX. TESTS AND MEASUREMENTS (2-3)
IND. ED. 410v, 410vX. INFLUENCES OF MODERN INDUSTRIAL LLFE ON INDUSTRIAL EDUCATION (2-3)
IND. ED. 412v, 412vX. SPECIAL PROBLEMS IN VOCATIONAL EDUCATION (2-4)
IND. ED. 414v, 414vX. VOCATIONAL EDUCATIONAL GUIDANCE (2-3)
IND. ED. 415v, 415vX. PROBLEMS IN CO-ORDINATING VOCATIONAL EDUCATION (2-3)
IND. ED. 418v, 418vX. PROBLEMS IN AUDIO-VISUAL AIDS IN INDUSTRIAL EDUCATION (2-3)
IND. ED. 420v, 420vX. OCCUPATIONAL HYGIENE (2-3)
IND. ED. 425v. WORKSHOP IN INDUSTRIAL EDUCATION (1-6)
IND. ED. 427v, 427vX. ADVANCED COURSE OF STUDY BUILDING (2-3)
IND. ED. 430v, 430vX. SAFETY EDUCATION FOR VOCATIONAL TEACHERS (2-3)
IND. ED. 436v, 436vX. ADULT EDUCATION IN INDUSTRIAL AMERICA (2-3)
IND. ED. 446v, 446vX. IMPROVEMENT OF INSTRUCTION IN VOCATIONAL EDUCATION (2-4)
IND. ED. 450v, 450vX. SHOP LAYOUT AND MANAGEMENT (2-3)
IND. ED. 458v. EMERGING PROBLEMS IN VOCATIONAL EDUCATION (1-7)
Unit A. Federal and State Laws Relating to Vocational Education (1)
Unit B. Framework of Federal, State, and Local Administrative Agencies (1)
Unit C. Federal, State, and Local Policies and Plans for Vocational Education (1)
Unit D. Local Administration of Vocational Education (1)
Unit E. Labor Laws and Labor Relations Affecting Education (1)
Unit F. Vocational Training for War and Postwar Eras (1)
Unit G. Problems in Vocational Rehabilitation of the Physically Handicapped (1)
IND. ED. 460. PROBLEMS IN VOCATIONAL REHABILITATION OF THE HANDICAPPED (1-6)
Unit A. The Counseling Interview in Vocational Rehabilitation (1-3)
Unit B. Occupational Information and Placement Techniques in Vocational Rehabilitation (1-3)

INDUSTRIAL ENGINEERING

PROFESSOR CLARENCE E. BULLINGER, I.E., M.S.
Head of the Department

I.E. 501. MANUFACTURING METHODS (2-8) Special projects including investigation, experimentation, design, and research of some one or more special types of manufacture. Seminar and practicum. *Professor C. E. Bullinger*

I.E. 502. Management Methods (3-6) Intensive study of the newer phases of scientific management, including production control and application of Gantt charts; research on special problems. Seminar and practicum.
Professor C. E. Bullinger

I.E. 503. Personnel Relations (2-8) Research on special topics. Seminar.
Professor C. E. Bullinger

I.E. 505. Graphical Computation (2-10) The construction of natural and logarithmic scales, applications of various co-ordinate papers and construction of nomographic or alignment charts; determination of empirical formulae from engineering data. Seminar and practicum. *Professor M. M. Babcock*

I.E. 506. Time and Motion Study (3-9) Machine data, elementary and fundamental machine times; determination of fatigue curves; design of Barth slide rules, micromotion study and chart plotting of micromotion results; chronocyclegraph study. Seminar. *Professor C. A. Anderson*

I.E. 507. Budgetary Control and Standard Costs (3-6) Divisional budgets as control media; establishing standard cost data, standard cost accounting procedures, and the use of cost variances in controlling manufacturing operations. Prerequisite: I.E. 401. Seminar. *Professor R. A. Hussey*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

I.E. 401. Industrial Accounts (4) *Professor R. A. Hussey*
I.E. 404. Scientific Management (2) *Professor C. E. Bullinger*
I.E. 406. Factory Planning (2) *Professor M. M. Babcock*
I.E. 409. Personnel Administration (3) *Professor G. D. Thomas*
I.E. 411. Manufacturing Budgets (2) *Professor R. A. Hussey*
I.E. 422a,b,c,d,e,f. Industrial Engineering Problems (2 per unit)
Professors M. M. Babcock, C. E. Bullinger, C. A. Anderson, R. A. Hussey, G. D. Thomas
I.E. 423. Quality Control (2-3) *Professor C. E. Bullinger*
I.E. 424. Job Evaluation (3) *Professor G. D. Thomas*

INSTITUTION ADMINISTRATION

Professor Esther A. Atkinson, M.S.
Head of the Department of Hotel and Institution Administration

Ind. Adm. 502. Problems in Institutional Administration (3-6) Individual study of problems in institutional administration. Prerequisites: In. Adm. 306, 330, 426. Lecture 2 hours; practicum, individual field work. *Professor E. A. Atkinson*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

In. Adm. 408. Equipment for Institutions (3)

In. Adm. 410. Tea Room Management (3)
In. Adm. 426. Institution Marketing (3)
In. Adm. 437a,b,cS. School Cafeteria Problems (1-3) Units A, B, C, 1 credit per unit.
In. Adm. 438. School Cafeteria (2-4)
In. Adm. 461. Institution Administration (3)
In. Adm. 462. Institution Experience (3)

ITALIAN

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

It. 571. Seminar in Italian Literature (3) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor. Recitation 3 hours.

JOURNALISM

Professor Franklin C. Banner, M.A.
Head of the Department

The following course may be taken for graduate credit under the restrictions in force:

Journ. 430S. Supervision and Management of School Publications (3)

LATIN

Professor Robert E. Dengler, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

Latin 500. Latin Literature (3) Lectures and collateral readings on the major forms of Latin literature; readings in the original Latin to supplement the lectures. *Professor R. E. Dengler*

Latin 501. Roman Religion and Philosophy (3) Primitive Roman religious concepts; their growth through contact with more mature cultures; the development of philosophic thought at Rome; the social and political status of society in the Roman empire in relation to the rise of Christianity. Lectures and reports. *Professor F. B. Krauss*

LATIN 502. LATIN EPIGRAPHY (3) Lectures and readings on Roman inscriptions; illustrative exercises. *Professor F. B. Krauss*

LATIN 503. LATIN PALEOGRAPHY (3) The Latin alphabet, writing materials, Roman book and cursive hands; illustrative exercises. *Professor R. E. Dengler*

LATIN 504. ROMAN TOPOGRAPHY (3) The physical development of the city of Rome, its walls, aqueducts, bridges, streets, fora, public buildings, temples, etc.; building materials and methods of construction. Lectures and reports. *Professor F. B. Krauss*

LATIN 510. LATIN SEMINAR (3)

LATIN 518. LATIN RESEARCH (1-3) Prosecution of an assigned problem under the guidance of a member of the department. *Professor R. E. Dengler*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

LATIN 428. LUCRETIUS (3) *Professor F. B. Krauss*
LATIN 429. QUINTILIAN (3) *Professor F. B. Krauss*
LATIN 431. JUVENAL (3) *Professor F. B. Krauss*
LATIN 436S. FUNCTIONAL PROBLEMS IN LATIN (3)
LATIN 440a,b,c,dS. COLLEGE LATIN (3-12) *Professor R. E. Dengler*

LIBRARY SCIENCE

Consult LIBRARIAN RALPH W. MCCOMB, M.A.

The following courses may be taken for graduate credit under the restrictions in force:

LIB. SCI. 403S. INTERMEDIATE DICTIONARY CATALOGUING AND SUBJECT HEADINGS (2-3)
LIB. SCI. 405S. INTERMEDIATE REFERENCE WORK AND BIBLIOGRAPHY (2-3)

MATHEMATICS

PROFESSOR ORRIN FRINK, JR., M.A., Ph.D.
Head of the Department

MATH. 500. ANALYTICAL MECHANICS (3) An exposition of rigid dynamics, the potential function, and Lagrange's equations. Prerequisite: Math. 419. Lecture 3 hours.

MATH. 501. THEORY OF FUNCTIONS OF A REAL VARIABLE (3) Theory of point sets; of continuous and discontinuous functions of a real variable, together with the study of their derivatives and of their integrals in both the Riemann and Lebesgue sense. Prerequisite: Math. 420. Lecture 3 hours.

MATH. 502. THEORY OF FUNCTIONS OF A REAL VARIABLE (3) Continuation of Math. 501. Lecture 3 hours.

MATH. 503. FOURIER SERIES AND HARMONIC FUNCTIONS (3) Fourier series and integrals; spherical harmonics, Bessel functions, etc., with special emphasis on their applications. Prerequisite: Math. 405.

MATH. 505. INTEGRAL EQUATIONS AND THEIR APPLICATION TO MATHEMATICAL PHYSICS (2) The solution of the equations of Fredholm and Volterra, together with their application to problems of geometry and analysis, to boundary problems in physics, etc. Prerequisite: Math. 405. Lecture 2 hours.

MATH. 506. INTEGRAL EQUATIONS AND THEIR APPLICATION TO MATHEMATICAL PHYSICS (2) Continuation of Math. 505. Lecture 2 hours.

MATH. 507. CALCULUS OF VARIATIONS (3) Prerequisites: Math. 421, 431. Lecture 3 hours.

MATH. 508. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (3) A logical development of the complex number system and the fundamental operations of complex numbers; the theory of analytic functions of a complex variable. Prerequisite: Math. 420. Lecture and exercises 3 hours.

MATH. 509. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (3) Continuation of Math. 508. Lecture and exercises 3 hours.

MATH. 510. THEORY OF GROUPS (3) General properties of groups with applications. Prerequisite: Math. 11. Lecture 3 hours.

MATH. 511. INTRODUCTION TO HIGHER ALGEBRA (3) Algebra of matrices, determinants, bilinear and quadratic forms. Prerequisites: Math. 9, 11. Lecture and exercises 3 hours.

MATH. 512. INTRODUCTION TO HIGHER ALGEBRA (3) Continuation of Math. 511. Lecture and exercises 3 hours.

MATH. 513. ADVANCED ANALYTIC GEOMETRY (3) Introduction of homogeneous co-ordinates and their use in the study of projective properties. Prerequisite: Math. 30.

MATH. 514. ADVANCED ANALYTIC GEOMETRY (3) Continuation of Math. 513.

MATH. 520. PROJECTIVE GEOMETRY (3) A general study of the subject from the postulational standpoint. Prerequisite: Math. 30. Lecture 3 hours. Alternate years or as required.

MATH. 521. PROJECTIVE GEOMETRY (3) Continuation of Math. 520. Lecture 3 hours. Alternate years or as required.

MATH. 522. METRIC DIFFERENTIAL GEOMETRY (3) The usual classical treatment of the subject. Prerequisite: Math. 11 or 30.

MATH. 523. DIFFERENTIAL GEOMETRY (3) Continuation of Math. 522.

MATH. 524. PROJECTIVE DIFFERENTIAL GEOMETRY (3) Study of the classic methods of Wilcznski, Lane, Fubini, etc. Prerequisite: Math. 514. Lecture 3 hours.

MATH. 525. PROJECTIVE DIFFERENTIAL GEOMETRY (3) Continuation of Math. 524. Lecture 3 hours.

MATH. 526. ALGEBRAIC GEOMETRY (3) Involutions on rational curves and related topics. Prerequisite: Math 514. Lecture 3 hours.

MATH. 527. ALGEBRAIC GEOMETRY (3) Continuation of Math 526. Lecture 3 hours.

MATH. 530. ANALYSIS SITUS (3) Combinatorial analysis situs with application, abstract spaces, continuous curves, and the theory of dimensionality. Prerequisite: Math. 501.

MATH. 531. ANALYSIS SITUS (3) Continuation of Math. 530.

MATH. 532. THEORY OF SETS (3) Theory of abstract sets; cardinal and ordinal numbers; sets of points in Euclidean space and in general metric space; theory of measure with applications to geometry and function theory. Prerequisite: general mathematical maturity. Lecture 3 hours.

MATH. 533. THEORY OF SETS (3) Continuation of Math. 532. Prerequisite: Math. 532. Lecture 3 hours.

MATH. 534. THEORY OF ALGEBRAIC NUMBERS (3) An introduction to the number theory of quadratic fields, with a study of the theory of ideals in quadratic and higher fields, with application. Prerequisite: Math. 404.

MATH. 535. MODERN ALGEBRAIC THEORIES (3) Algebraic invariants, matrices, quadratic and Hermitian forms, Galois theory of equations, modular systems, etc. Prerequisite: general mathematical maturity. Lecture 3 hours.

MATH. 536. MODERN ALGEBRAIC THEORIES (3) Continuation of Math. 535. Lecture 3 hours.

MATH. 540. THEORY OF RELATIVITY (3) An introduction to the subject by a study of the Riemann Einstein space. Prerequisites: Math 405, 417, 431.

MATH. 541. THEORY OF RELATIVITY (3) Continuation of Math. 540.

MATH. 550. MATHEMATICAL LOGIC (3) The logical basis of mathematics and its ultimate nature. Prerequisite: general mathematical maturity. Lecture 3 hours.

MATH. 552. NUMERICAL METHODS (3) Procedures for practical calculation, including interpolation, solution of equations, iterative methods, harmonic analysis, and use of modern calculating equipment. Prerequisite: Math. 420. Lecture 3 hours.

MATH. 553. NUMERICAL METHODS (3) Continuation of Math. 552. Prerequisite: Math. 552. Lecture 3 hours.

MATH. 560. THEORY OF DIFFERENTIAL EQUATIONS (3)

MATH. 561. THEORY OF DIFFERENTIAL EQUATIONS (3) Continuation of Math. 560.

MATH. 570. SPECIAL TOPICS IN GEOMETRY (3-6)

MATH. 571. SPECIAL TOPICS IN ANALYSIS (3-6)

MATH. 575. MATHEMATICS SEMINAR (2-6) Selected topics from recent mathematical developments. Prerequisite: general mathematical maturity. Lecture 2 hours.

MATH. 576. MATHEMATICS SEMINAR (2-6) Continuation of Math. 575. Lecture 2 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MATH. 401. COLLEGE GEOMETRY (3)
MATH. 403. MODERN METHODS IN GEOMETRY (3)
MATH. 404. THEORY OF NUMBERS (3)
MATH. 405. PARTIAL DIFFERENTIAL EQUATIONS (3)
MATH. 409. THEORY OF PROBABILITY (3)
MATH. 410. STATISTICAL METHODS (3)
MATH. 411. FINITE DIFFERENCES (3)
MATH. 417. VECTOR ANALYSIS (3)
MATH. 419. ANALYTICAL MECHANICS (3)
MATH. 420. ADVANCED CALCULUS (3)
MATH. 421. ADVANCED CALCULUS (3)
MATH. 424. LEAST SQUARES (2)
MATH. 425. CURVE FITTING (1)
MATH. 431. DIFFERENTIAL EQUATIONS (3)
MATH. 440. THEORY OF EQUATIONS (3)
MATH. 441. THEORY OF EQUATIONS (3)
MATH. 451. INTRODUCTION TO APPLIED MATHEMATICS (3-6)
MATH. 452. INTRODUCTION TO APPLIED MATHEMATICS (3-6)
MATH. 471. FOUNDATIONS OF ALGEBRA (3)
MATH. 472. FOUNDATIONS OF GEOMETRY (3)

MECHANICAL ENGINEERING

PROFESSOR NORMAN R. SPARKS, M.E.
Head of the Department

M.E. 502. ADVANCED GAS TURBINES (3-6) The thermodynamic and stress analysis design of gas turbine and compressor units. Prerequisite: M.E. 409.

M.E. 504. ADVANCED THERMODYNAMICS (3-6) Pure and applied thermodynamics including its application to advanced engineering problems; collateral reading and discussion of the classical works on the subject. Prerequisite: M.E. 3 or 104.

M.E. 505. HEAT TRANSMISSION (3-6) Applications of principles of heat transfer to efficient design of mechanical engineering equipment. Prerequisite: M.E. 412.

M.E. 506. Mechanical Engineering Seminar (1-4) Advanced courses adapted to the individual requirements of graduates in mechanical engineering.

M.E. 507. Advanced Internal Combustion Engines (3) Design and performance of both carburetor and fuel injection type reciprocating engines primarily from the thermodynamic viewpoint, with emphasis on the economics of operation. Prerequisites: M.E. 413, 504. Lecture 3 hours.

M.E. 508. Mechanical Engineering Research (1-9) Research related to the mechanical engineering major subject; work must show evidence of original thinking; may be scheduled as thesis work for the M.S. degree.

M.E. 509. Heat Engineering Seminar (2-6) Advanced studies in design and performance of heat equipment, direct-fired and unfired; adapted to the individual requirements of graduates in mechanical engineering. Prerequisite: M.E. 6.

MECHANICAL ENGINEERING DESIGN

M.E. Des. 502. Friction and Lubrication (3) The hydrodynamic theory of lubrication, and the methods of applying it to bearing design, together with a survey of methods of testing lubricants.

M.E. Des. 505. Advanced Dynamics of Machines (3-6) Linear and torsional vibrations in and balancing of rotating and reciprocating machinery; an exact analysis of the stresses produced by these and other dynamic forces in machine parts. Prerequisites: Mchs. 12, M.E. Des. 8.

MECHANICAL ENGINEERING LABORATORY

M.E. Lab. 501. Investigation Projects (2-6) Special experimental studies or investigations in mechanical engineering, adapted to individual requirements.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

M.E. 401a,b,c,d. Mechanical Engineering (3-12)
M.E. 402. Air Conditioning (3)
M.E. 408. Steam Turbines (3)
M.E. 409. Gas Turbines (3)
M.E. 410. Steam Power Plants (3)
M.E. 411. Refrigeration (3)
M.E. 412. Fundamentals of Heat Transfer (3)
M.E. 413. Internal Combustion Engines (3)
M.E. 415. Heat Transfer Processes in Commercial Manufacturing (3)
M.E. 416. Resistance and Powering of Ships (3)
M.E. Des. 402. Design of Machine Tools (3)

METALLURGY

PROFESSOR JAY W. FREDRICKSON, Ph.D.
Chief of the Division

MET. 500. METALLURGICAL RESEARCH (3-15 per semester) Research on special topics; conferences, reading, and library work. Results may be embodied in a thesis. Prerequisites: Met. 411, 413.

MET. 501. METALLURGICAL PROBLEMS (1-6 per semester) Independent study of special problems in metallurgy. Prerequisites: Met. 411, 413. Practicum 3 to 18 hours.

MET. 502. METALLURGICAL SEMINAR (1 per semester) Conferences, reading, and reports. Required of all graduate students in metallurgy.

MET. 515. CORROSION AND PROTECTION OF METALLIC SURFACES (3) The phenomena and theories of corrosion processes from the viewpoint of the metallurgist; the chemistry and metallurgy of metal protection by electroplating, anodizing, galvanizing, tinning, metal spraying, and other metallurgical surface treatments, in both theoretical and practical aspects. Prerequisites: Met. 411, 413. Lecture 3 hours. *Professor H. J. Read*

MET. 516. MECHANICAL METALLURGY (3) Theory of plastic flow and rupture of polycrystalline metals; the influence of combined stresses, rate of deformation and temperature variation on the flow and rupture of metals; the applications of theory to metal forming operations and the interpretation of mechanical test results. Prerequisites: Met. 411, 413. Lecture 3 hours.

MET. 517. ADVANCED NONFERROUS METALLURGY (3) Theory of chemical processes in the extractive metallurgy of the principal nonferrous metals; particular attention to electrometallurgical operations in the fields of electrowinning and electrorefining, and to processes involving the vapor phase. Prerequisites: Met. 411, 413. Lecture 3 hours. *Professor H. J. Read*

MET. 518. CONSTITUTION OF METALLURGICAL SYSTEMS (3) Application of thermodynamic principles to the study of gas-metal, slag-metal, and complex alloy systems; equilibrium and rates of reaction in metal extractions and refining processes. Constitution of complex alloys. Prerequisites: Met. 411, 413. Lecture 3 hours. *Professor H. M. Davis*

MET. 519. ADVANCED FERROUS METALLURGY (3) Theory of the chemical processes in the smelting, refining, and deoxidation of iron and steel; slag and metal bath control methods; ingot solidification and primary forging operations, and their relation to the properties of wrought steel products. Prerequisites: Met. 411, 413. Lecture 3 hours.

MET. 520. FOUNDRY METALLURGY (3) The principles of foundry metallurgy and their application to foundry operations for various casting alloys; specific attention to steels, cast irons, and the nonferrous metals with respect to the metallurgy and operations involved in their founding. Prerequisites: Met. 411, 413. Lecture 3 hours. *Professor R. W. Lindsay*

MET. 521. ENGINEERING ALLOYS (3) Ferrous and nonferrous alloys used for special purposes such as tool steels, electrical sheets, and corrosion and heat-resisting alloys; the various alloys available for each application are compared on the basis of properties and relative cost; discussion based upon the metallography and constitution of the particular alloy systems involved. Prerequisites: Met. 411, 413. Lecture 3 hours. *Professor R. W. Lindsay*

MET. 522. SOLID PHASE REACTIONS IN METALS (3) Mechanism and rate determining factors in solid phase reactions in metals; diffusion processes, nucleation theory, precipitation from solid solution, eutectoid, decomposition and order-disorder phenomena. Prerequisites: Met. 411, 413. Lecture 3 hours.
Professor E. P. Klier

MET. 523. BEHAVIOR OF METAL CRYSTALS (3) Plastic action in single crystals of metals and in polycrystalline metals, theoretical crystal plasticity, recovery, and recrystallization, deformation and recrystallization textures, anistropy in general. Prerequisites: Met. 411, 413. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MET. 405. FERROUS METALLOGRAPHY (3)
MET. 406. NONFERROUS METALLOGRAPHY (3)
MET. 407. METALLURGICAL ENGINEERING I (3)
MET. 408. METALLURGICAL ENGINEERING II (3)
MET. 409. METALLURGICAL INVESTIGATIONS I (3)
MET. 410. METALLURGICAL INVESTIGATIONS II (3)
MET. 411. ADVANCED PHYSICAL METALLURGY (3)
MET. 412. EXPERIMENTAL METALLURGY (3)
MET. 413. ADVANCED CHEMICAL METALLURGY (3)

METEOROLOGY

PROFESSOR HANS NEUBERGER, D.Sc.
Chief of the Division

METEOR. 500. METEOROLOGICAL SEMINAR (1-3) Discussion of meteorological reports and papers; scientific outlook. Prerequisites: Meteor. 421, 441, 451. Lecture 1 to 3 hours.

METEOR. 501. METEOROLOGICAL RESEARCH (3-15) Research work in physical, synoptic, dynamic meteorology; climatology. Prerequisites: a minimum of one year of physics, calculus, and differential equations, 15 credits in meteorology. Practicum 3 hours per credit.

METEOR. 502. SELECTED TOPICS OF ADVANCED METEOROLOGY (2) Lectures, review, and discussion of current problems in meteorology. Prerequisite: a minimum of 15 credits in meteorology. Lecture 2 hours.

METEOR. 504. THEORETICAL AND DYNAMIC METEOROLOGY (3) Mathematical analysis of meteorological phenomena; theory of circulation; deformation fields. Prerequisite: Meteor. 452. Lecture 3 hours.

METEOR. 505. BIOCLIMATOLOGY (2) Climatic phenomena in their relation to life. Prerequisite: Meteor. 372. Lecture 2 hours.

METEOR. 506. ADVANCED METEOROLOGICAL ANALYSIS (2-6) Physical analysis of atmospheric phenomena; synoptic analysis of weather phenomena for advanced students. Prerequisite: Meteor. 421. Lecture 1 hour, practicum 3 to 15 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

METEOR. 421. SYNOPTIC METEOROLOGY I (3)
METEOR. 422. SYNOPTIC METEOROLOGY II (3)
METEOR. 431. SYNOPTIC METEOROLOGY LABORATORY I (2)
METEOR. 432. SYNOPTIC METEOROLOGY LABORATORY II (2-10)
METEOR. 441. PHYSICAL METEOROLOGY I (2)
METEOR. 442. PHYSICAL METEOROLOGY II (2)
METEOR. 451. DYNAMIC METEOROLOGY I (3)
METEOR. 452. DYNAMIC METEOROLOGY II (3)
METEOR. 453. PROBLEMS IN DYNAMIC METEOROLOGY (1)
METEOR. 492. METEOROLOGICAL SEMINAR (2)

MINERAL ECONOMICS

PROFESSOR W. M. MYERS, M.S., Ph.D.
Chief of the Division

MIN. ECON. 500. MARKETING OF MINERALS AND MINERAL PRODUCTS (3-6) Research in mineral marketing problems. Prerequisite: Min. Econ. 453.
Professor W. M. Myers

MIN. ECON. 501. RESEARCH IN MINERAL ECONOMICS (3-6) Investigation in specialized fields of research in mineral economics. Prerequisite: Min. Econ. 453.
Professor W. M. Myers

MIN. ECON. 502. TECHNOLOGIC INFLUENCES (3-9) The relationship of technologic advancements to the financial development of the mineral industries. Prerequisites: Min. Econ. 87, 483.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MIN. ECON. 400. SEMINAR (1) *Professor W. M. Myers*
MIN. ECON. 453. NONMETALLIC MINERALS (3) *Professor W. M. Myers*
MIN. ECON. 483. THE METALS AND THEIR ORES (3) *Professor W. M. Myers*
MIN. ECON. 484. THE FUELS (3) *Professor W. M. Myers*

MINERAL PREPARATION

PROFESSOR RAYMOND E. ZIMMERMAN, E.M.
Chief of the Division

MIN. PREP. 502. FROTH FLOTATION AND AGGLOMERATION (3) An intensive study of the theory and applications of froth flotation and agglomeration. Prerequisite: Min. Prep. 405. Lecture 3 hours. *Professor S. C. Sun*

MIN. PREP. 504. MINERAL PREPARATION RESEARCH (3-10) Research work on specific problems in mineral preparation. Prerequisite: Min. Prep. 405 or 410. Practicum 9 to 30 hours.

MIN. PREP. 505. GRAVITY PROCESSES AND MISCELLANEOUS METHODS OF MINERAL PREPARATION (3) An intensive study of the theory and applications of gravity, magnetic, electrostatic, centrifugal, and dense-media processes of mineral concentration. Prerequisite: Min. Prep. 405. Lecture 3 hours.

MIN. PREP. 506. MINERAL PREPARATION PLANT DESIGN (3-10) The layout, design, and selection of equipment for specific mineral preparation plant projects. Prerequisite: Min. Prep. 405. Practicum 9 to 30 hours.
Professor R. E. Zimmerman

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MIN. PREP. 400. MINERAL PREPARATION SEMINAR (1)
MIN. PREP. 403. FLOWSHEETS OF MINERAL PREPARATION PLANTS (2)
MIN. PREP. 404. PLANT LAYOUT AND DESIGN (2)
MIN. PREP. 405. UNIT OPERATIONS (4)
MIN. PREP. 406. MINERAL PREPARATION TESTING (2)
MIN. PREP. 410. COAL PREPARATION (3) *Professor R. E. Zimmerman*

MINERALOGY

PROFESSOR PAUL D. KRYNINE, Ph.D.
Chief of the Division

MIN. 500. PHYSICAL MINERALOGY (3) Optical methods and measurement of optical constants of minerals. Seminar 1 hour, practicum 6 hours.
Professors P. D. Krynine, T. F. Bates

MIN. 501a. PETROLOGY (3-6) Microscopic study of rocks, emphasizing classification and genetic relationships. Seminar and practicum.
Professors P. D. Krynine, E. F. Osborn, J. C. Griffiths

*MIN. 502a. MINERALOGICAL RESEARCH (3-18) An original study of some mineralogical problem, results of which may be applied on the thesis requirements.

* Credits to be arranged, 3-9 per semester.

MIN. 504. THEORETICAL MINERALOGY (2) Selected topics in crystal chemistry and crystal physics applied to solid solution, polymorphism, crystal growth, and related phenomena; laboratory studies of identification techniques including X-ray diffraction. Prerequisite: Min. 461. Lecture 2 hours. *Professor T. F. Bates*

†MIN. 505. MINERALOGY SEMINAR (1-2) Reading, presentation, and discussion of literature dealing with various phases of theoretical mineralogy. Topics are selected to meet the interests of the majority of the students. Lecture 1 hour.
Professors P. D. Krynine, E. F. Osborn, T. F. Bates, J. C. Griffiths

‡MIN. 507. PHYSICOCHEMICAL PETROGRAPHY (3) Advanced work in the constitution and phase relations of inorganic crystals and liquids; special emphasis on silicate compounds and glasses. Prerequisite: Min. 483. Lecture 3 hours.
Professor E. F. Osborn

‡MIN. 508. PHYSICOCHEMICAL PETROLOGY (3) Application of the principles of physicochemical petrography to the origin of igneous and metamorphic rocks; the distribution of elements in the earth's crust. Prerequisite: Min. 507. Lecture 2 hours, practicum 3 hours. *Professor E. F. Osborn*

§MIN. 510. METAMORPHISM (2-6) A detailed review of chemical mineralogical and structural changes that take place during metamorphism. Prerequisite: Min. 483. Lecture 1 to 4 hours, practicum 3 to 6 hours.
Professors P. D. Krynine, E. F. Osborn, T. F. Bates, J. C. Griffiths

‖MIN. 511. BASIC SEDIMENTOLOGY (3-4) Composition, texture, structure, mass properties of sediments; dynamic processes in complex natural systems; sedimentary stages: weathering, erosion, transport, deposition, and lithification. Prerequisite: Min. 483. Concurrent: Min. 513. Lecture 2 hours, practicum 3 to 6 hours.
Professor P. D. Krynine

‖MIN. 512. BASIC SEDIMENTOLOGY, CONTINUED (3-4) Diastrophism and tectonic background of sedimentation; depositional loci; classification of sediments: the quartzites, graywackes, and arkoses; chemical sediments; paleogeography, paleoclimatology, oil finding. Prerequisite: Min. 511. Concurrent: Min. 514. Lecture 2 hours, practicum 3 to 6 hours. *Professor P. D. Krynine*

MIN. 513. METHODS OF ANALYSIS OF SEDIMENTS (2) Principles and practices used in analyzing sedimentary rocks for size, shape, and accessory (heavy) minerals. Concurrent: Min. 511. Lecture 1 hour, practicum 3 hours.
Professor J. C. Griffiths

MIN. 514. APPLIED SEDIMENTOLOGY (2) Design and control in analysis of sedimentary rocks; application of these techniques to industrial problems. Concurrent: Min. 512. Lecture 1 hour, practicum 3 hours. *Professor J. C. Griffiths*

MIN. 515. MINERALOGY OF CLAYS AND OTHER FINE-GRAINED MATERIALS (2-3) The physical and chemical properties of clay minerals; importance and application of

† Credits to be arranged, 1 per semester.
‡ Credits to be aranged, 1-3 per semester.
§ Credits to be arranged, 2-4 per semester.
‖ Credits to be arranged, 3-4 per semester.

X-ray diffraction, differential thermal analysis, light and electron microscopy. Prerequisite: Min. 460. Lecture 1 hour, practicum 3 to 6 hours.

Professors T. F. Bates, J. C. Griffiths

¶Min. 516. Petrology of Fine-Grained Sediments (2-3) The fine-grained sedimentary rocks and their industrial applications. Prerequisite: Min. 515. Lecture 1 hour, practicum 3 to 6 hours. *Professors J. C. Griffiths, T. F. Bates*

‡Min. 517. European Sediments (1-6) Interpretative microscopic and hand specimen study of selected rock suites from Europe and Asia; correlation with paleogeographic and tectonic data. Prerequisites: Min. 512, 514.

Professor P. D. Krynine

§Min. 518. American Sediments (2-8) Thin section, heavy residue, textural and field data of arkoses, graywackes, quartzites, and carbonates from representative North American sedimentary provinces. Prerequisites: Min. 512, 514, 516.

Professor P. D. Krynine

¶Min. 519. Oil Reservoir Petrology (2-6) The petrographic fundamentals controlling porosity, storage capacity, oil accumulation, effective permeability, fluid yield and retention, exploration and production methods. Prerequisites: Min. 512, 514, 516. *Professors P. D. Krynine, J. C. Griffiths*

§Min. 520. Study of Accessory Minerals (2-4) Detailed study of accessory (heavy) minerals; their significance in problems of provenance, petrogenesis, mineral stratigraphy, and paleogeography. Prerequisites: Min. 511, 512, 513, 514. Lecture 1 hour, practicum 3 to 6 hours. *Professor J. C. Griffiths*

Min. 521. Color in Minerals (1-2) The nature of light absorption as a function of chemical composition for solutions, glasses, and minerals.

Professor Woldemar Weyl

¶Min. 522. The Electron Microscope in Mineralogical and Geological Problems (2-6) Laboratory investigation of geological subjects at high magnification; correlation of data with those obtained by other methods of study.

Professor T. F. Bates

¶Min. 523. X-Ray Diffraction Studies of Minerals (2-6) Investigation of mineralogical problems with X-rays. Practicum includes preparation of samples, use of X-ray apparatus, and interpretation of patterns. Prerequisite: Min. 461.

Professor T. F. Bates

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Min. 460. Physical Mineralogy (3) *Professor T. F. Bates*
Min. 461. Descriptive Mineralogy (4) *Professor T. F. Bates*
Min. 483. Petrography (4) *Professor J. C. Griffiths*

‡ Credits to be arranged, 1-3 per semester.
§ Credits to be arranged, 2-4 per semester.
¶ Credits to be arranged, 2-3 per semester.

MINING

PROFESSOR ARNOLD W. ASMAN, B.Sc.
Chief of the Division

MNG. 500. MINING SEMINAR (2) Conferences, reading, and reports. Scientific management; public relations; technological developments. Required of all graduate students in mining engineering. Lecture 2 hours.

MNG. 501. MINE ENGINEERING (3) Mine mechanization problems. The selection of the most suitable equipment for various conditions. Prerequisite: Mng. 488. Lecture 3 hours.

MNG. 504. MINING RESEARCH (3-10 per semester) Research work on specific problems in physics of mining and mine mechanization. Prerequisites: Mng. 481. Practicum 9 to 30 hours.

MNG. 506. MINE AND MINE PLANT DESIGN (3-10) The layout, design, and selection of equipment for specific mining and mine plant projects. Prerequisite: Mng. 499. Practicum 9 to 30 hours.

MNG. 520. MINE PLANNING USING CYCLE STUDIES (3-6) Highly productive cycles of mine section operation are developed by use of time and method studies of the various sub-cycles involved. Prerequisite: Mng. 72.

MNG. 521. MATHEMATICAL ANALYSIS OF MINE LAYOUTS (3) Proportioning layouts in regard to mineral available, distances, and centroids of mining areas; incremental and sub-cycle costs. Prerequisite: Mng. 488.

MNG. 522. ROCK MECHANICS (3-6) A detailed study of the physical properties of rocks as affecting the design of underground openings; testing procedures, calculations, and design. Prerequisite: Mng. 499.

MNG. 523. MINE DUSTS (3) Detailed studies of methods of collecting, sampling, and determining the amount, size, and mineral content of dust in mine atmospheres; methods of dust control. Prerequisite: Mng. 481.

MNG. 524. UNDERGROUND MINING POWER DISTRIBUTION SYSTEMS (3-6) Calculations involved in the design of power applications and systems for mines; electrical, compressed air; Diesels; package power for extremely gassy conditions; sectionalizing; loads and load centers. Prerequisite: Mng. 488.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MNG. 400. MINE SAFETY ENGINEERING (2)
MNG. 481. PHYSICS OF MINING (4)
MNG. 483. MINERAL PROPERTY VALUATION (2)
MNG. 488. ADVANCED MINE MECHANIZATION (2)
MNG. 499. ADVANCED MINING DESIGN (2)

MUSIC

PROFESSOR HUMMEL FISHBURN, M.A.
Head of the Department

MUSIC 503-506. ADVANCED STRINGED INSTRUMENTS (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 103-106. Recitation 2 hours, practicum 5 hours. Fee $25 per course. *Professor Theodore Karhan*

MUSIC 511-514. ADVANCED PIANO (3 per course) Artistic performance of piano literature of all periods; program building stressed according to individual taste and ability; designed to help students prepare for the demands of successful public performance; technique, interpretation, memory, and the qualities that make for musicianship and poise at the piano. Fee $25 per course.
Professor B. S. Brinsmaid

MUSIC 531-534. ADVANCED ORGAN (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 31-34. Recitation 2 hours, practicum 5 hours. Fee $30 per course. *Professor G. E. Ceiga*

MUSIC 558-561. FREE COMPOSITION (3 per course) An opportunity for graduate students to do original work under supervision. Weekly conferences; analysis and discussion of the style and technique of standard and contemporary composers; experimental writing in various styles. Prerequisites: harmony 12 credits, piano 8 credits. *Professor G. W. Henninger*

MUSIC 563. FREE ARRANGING (3) Correct procedure in arranging for vocal and instrumental ensembles; practical exercises in quartets, glee clubs, and choruses; small instrumental groups, band, and orchestra. Prerequisites: harmony 18 credits, including 3 of orchestration. *Professor Hummel Fishburn*

MUSIC 567. THE LITERATURE OF THE ORCHESTRA (3) Outstanding orchestra works of great composers of that medium, from the appreciation and historic point of view; analysis of the form and styles of the suite, the symphony, the tone poem, and the overture; survey of instrumentation and orchestration from the early chamber group to the present symphony orchestra. Prerequisites: Music 6 and theoretical knowledge of the key instruments of the orchestra.
Professor Hummel Fishburn

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MUSIC 407. PIANO REPERTOIRE (3) *Professor B. S. Brinsmaid*
MUSIC 408. VOCAL LITERATURE (3) *Mrs. Elizabeth Reynolds*
MUSIC 429-432. SINGER'S STYLE AND INTERPRETATION (3 per course) Fee $25 per course. *Professor Willa Taylor*
MUSIC 456. ELEMENTARY COUNTERPOINT (3) *Professor G. W. Henninger*
MUSIC 464. MUSICAL LITERATURE OF THE ROMANTIC PERIOD (3)
Professor Hummel Fishburn
MUSIC 465. MUSICAL LITERATURE OF THE MODERN PERIOD (3)
Professor Hummel Fishburn
MUSIC 466. ADVANCED CONDUCTING (3) *Professor Frank Gullo*

MUSIC EDUCATION

PROFESSOR HUMMEL FISHBURN, M.A.
Head of the Department

MUSIC ED. 500. MUSIC EDUCATION SEMINAR (3-6) Problems of various phases of music education, both instrumental and vocal; research and literature dealing with these problems.

MUSIC ED. 571. VOCAL PEDAGOGY (3) Practical ways of solving problems in teaching public school vocal music; physiological, acoustic, and psychological factors of singing; investigation of traditional methods of training singers; voice class pedagogy and procedures for conducting high school voice training classes. Prerequisites: Music Ed. 48 and teaching experience.

MUSIC ED. 572. INSTRUMENTAL PEDAGOGY (3-6) Research problems in the fields of band and orchestra. Prerequisite: Music Ed. 54 or practical experience.

MUSIC ED. 573. THE MATERIALS OF APPRECIATION (3) Designed to acquaint the teacher of music appreciation with recorded material available for appreciation classes; special emphasis on materials for courses in secondary schools, colleges, and for adult groups, as well as recordings that can be used by instrumental and vocal teachers in their work outside of appreciation classes. Prerequisites: Music 5, and teaching experience.

MUSIC ED. 574a,b. PRESENT-DAY TRENDS IN MUSIC EDUCATION (3-6) Present-day trends in music education in the elementary school with special emphasis upon relationship of music to the entire school program; co-ordination of various types of musical activities; current materials and practices; practical and specific problems of teaching and organization of immediate importance to the personnel of the class. Prerequisites: Music Ed. 48 and teaching experience.

MUSIC ED. 575. THE JUNIOR HIGH SCHOOL MUSIC CURRICULUM (3) Instructional materials, procedures, curricular and extracurricular activities, integration with other subjects. Lecture 3 hours.

MUSIC ED. 590. THESIS (3-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MUSIC ED. 462. PEDAGOGY OF THEORY (3)

MUSIC ED. 468. THE TEACHING OF PIANO (3)

MUSIC ED. 469. BAND AND ORCHESTRA TECHNIQUE (3)

MUSIC ED. 470. CHORAL TECHNIQUE (3)

MUSIC ED. 475. OBJECTIVES AND PROBLEMS IN ELEMENTARY MUSIC EDUCATION (3)

PETROLEUM AND NATURAL GAS

Professor Ralph F. Nielsen, M.S., Ph.D.
Acting Chief of the Division

Pet.E. 500a. Petroleum and Natural Gas Engineering Research (3-9 per semester)

Pet.E. 501. Energetics of Petroleum Engineering (3) Fundamental laws and systematic derivation of formulae with applications to production of petroleum and natural gas; energetics of phase equilibria; use of partial quantities in field problems; deviations from simple mixture laws; applications of material and energy balances. Prerequisite or concurrent: M.E. 104, Pet.E. 481. Lecture 3 hours.

Pet. E. 502a. Petroleum and Natural Gas Engineering Seminar (3-9) An intensive study of one or several phases of petroleum engineering.

Pet. E. 503. The Flow of Homogeneous Fluids Through Porous Media (3) The mathematical relations governing the flow of homogeneous liquids through porous media; rate of flow and pressure distribution according to various well spacing patterns; application to water flooding and gas repressuring. Prerequisites: Math. 431, Pet.E. 74. Lecture 3 hours.

Pet.E. 504. Water Flooding (3-6) Fundamental physical forces involved in water flooding, core data interpretation, well spacing, pattern layout, shooting, water treatment, pressure plant, methods of pumping, delayed drilling, selective plugging, use of gas in water flooding, production curtailment, and the economics of water flooding. (Course may be expanded to 6 hours credit with special laboratory problem.) Prerequisite: Chem. 40. Lecture 2 hours, practicum 3 hours.

Pet.E. 506. Advanced Petroleum Engineering (5) Flow of oil and gas mixtures in vertical pipes; application of the vibration theory to deep well pumping; corrosion of oil field equipment, cathodic protection; production chemistry; mechanical and chemical selective exclusion of liquids from wells; field treatment of crudes, emulsions, field refining of crudes, and salt water disposal. Prerequisites: Chem. 41, Pet.E. 74. Lecture 4 hours, practicum 3 hours.

Pet.E. 507. Condensate Fields (2) Retrograde condensation phenomenon of hydrocarbon mixtures at high pressure; literature on condensate fields; production methods and equipment design: casing heads, compressors, separators, stabilizers; safety measures. Prerequisite: Pet.E. 501. Lecture 2 hours.

Pet.E. 508. Colloidal Behavior of Industrial Clays, Muds, and Slimes (2-3) Colloidal activity in bodies, glazes, and enamels, drilling fluids, filtering and bleaching clays, and similar mineral systems. (In co-operation with the Ceramics staff.) Prerequisite: Chem. 41. Lecture 1 hour, recitation 1 or 2 hours.

Professor E. C. Henry

Pet.E. 509. Advanced Petroleum Engineering Design (2) Continuation of Pet.E. 84. Projects in the selection of engineering materials for casing programs, drilling rigs; production, treatment, stabilization, and transportation of crude oils. Prerequisite: Pet.E. 84. Lecture 1 hour, practicum 3 hours.

PET.E. 510. MODERN METHODS OF HYDROCARBON ANALYSES (3) Recently developed methods of analysis of hydrocarbon mixtures, principally infrared spectrum analysis, Raman spectrum analysis, magneto-optic analysis, mass spectrum analysis, etc. Lecture 2 hours, practicum 3 hours.

PET.E. LAB. 508. ROTARY DRILLING FLUID LABORATORY (1) Determination of size distribution of particles, electrodialysis, acid and base exchange capacity, ultimate pH, swelling of clays and its control, viscosity of muds and related properties, thixotropy, weighting materials. Prerequisite: Chem. 41. Concurrent: Pet.E. 508. Practicum 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PET.E. 481. NATURAL GAS AND GASOLINE PLANTS (4)
PET.E. 485. SECONDARY RECOVERY (3)
PET.E. 491. OIL AND GAS RESERVOIR ENGINEERING (3)
PET.E. 492. PETROLEUM ECONOMICS (3)
PET.E. LAB. 481. NATURAL GAS LABORATORY (1)
PET.E. LAB. 490. ADVANCED CORE TESTING (3)

PHILOSOPHY

PROFESSOR JOHN A. MOURANT, M.A., Ph.D.
Head of the Department

PHIL. 500a,b. ETHICAL SEMINAR (2-6) A critical study of some phase of ethical fact and theory.

PHIL. 501a,b,c,d. PHILOSOPHY SEMINAR (2-12) Meets the demand for advanced study in special fields of philosophical thought.

PHIL. 502. THEORY OF EPISTEMOLOGY (3) A systematic and critical analysis of some aspect of contemporary epistemology. Recitation 3 hours.

PHIL. 503. LOGIC (3) The logical basis of mathematics and its ultimate nature. Recitation 3 hours.

PHIL. 504. SOCIAL AND POLITICAL PHILOSOPHY (3) A critical study of basic problems in their historical and functional setting. Recitation 3 hours.

PHIL. 505. IDEALS OF WESTERN CIVILIZATION (3) An analysis of contemporary ideals in terms of their Graeco-Judean bases. Recitation 3 hours.

PHIL. 507. SEMINAR IN HISTORY OF PHILOSOPHY (3-12) Concentrated study of some work or problem in the history of philosophy. Recitation 3 to 12 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PHIL. 401. RELIGIOUS PHILOSOPHY OF THE GREAT REFORMERS (3)

PHIL. 402. 17TH AND 18TH CENTURY PHILOSOPHY (3)
PHIL. 408. ADVANCED SOCIAL AND POLITICAL PHILOSOPHY (3)
PHIL. 409. PHILOSOPHY OF ST. THOMAS AQUINAS (3)
PHIL. 418. RECENT AND CONTEMPORARY PHILOSOPHY (3)
PHIL. 427. ADVANCED ETHICS (3)
PHIL. 428. ADVANCED LOGIC (3)
PHIL. 430. HONORS COURSE IN PHILOSOPHY (3)

PHYSICAL EDUCATION

Consult PROFESSOR LLOYD M. JONES, M.A., Ph.D.

PHYS. ED. 500. PROBLEM IN PHYSICAL EDUCATION (3) Prerequisite: Phys. Ed. 455.

PHYS. ED. 522. ORGANIZATION AND ADMINISTRATION OF PHYSICAL EDUCATION IN COLLEGES AND UNIVERSITIES (3) Administration of physical education in college; credits, schedules, excuses, records, reports, budgets, classification, tests, staff, and facilities. Prerequisite: Phys. Ed. 491. *Professor G. N. Thiel*

PHYS. ED. 523. ADMINISTRATION OF COLLEGE ATHLETICS (3) Eligibility, schedules, managerial systems, the relationships of athletics to the physical education program and to education in general. Prerequisite: Phys. Ed. 491.
Professor F. J. Bedenk

PHYS. ED. 526. ATHLETIC PROBLEMS IN SCHOOLS (3) Practical problems which result from the administration of athletics in schools. Reports on some aspects of athletics required. Prerequisites: Phys. Ed. 460, 481. *Professor F. J. Bedenk*

PHYS. ED. 528. PROFESSIONAL EDUCATION OF TEACHERS OF HEALTH AND PHYSICAL EDUCATION (3) Health and physical education surveys, publicity, sociability and personality tests, legislation, state certification, standards for facilities and equipment, in-service, follow-up, and teacher-community problems. Prerequisite: Phys. Ed. 491. *Professor L. M. Jones*

PHYS. ED. 529. SUPERVISION OF PHYSICAL EDUCATION IN SCHOOLS (3) Methods and policies of the school supervisor of physical education; conferences, planning and presenting the program, evaluating results, improving teachers-in-service, supervision of the classroom teacher. Prerequisites: Phys. Ed. 452, 453, 491.
Professor L. M. Jones

PHYS. ED. 530. RESEARCH TECHNIQUES IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Phys. Ed. 490. *Professor J. D. Lawther*

PHYS. ED. 531. RESEARCH IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Phys. Ed. 530. *Professor L. M. Jones*

PHYS. ED. 532. TESTS AND MEASUREMENTS IN PHYSICAL EDUCATION (3) Critical study of the test and measurements available in physical education; methods of constructing and evaluating new tests and measurements. Prerequisite: Phys. Ed. 490. *Professor F. J. Bedenk*

PHYS. ED. 534. STUDIES IN CURRICULUM CONSTRUCTION IN PHYSICAL EDUCATION (3) Principles and methods of curriculum building in physical education; the different psychological and educational points of view, organizing a course of study committee, making units of instruction. Prerequisites: Phys. Ed. 452, 453, 454. *Professor L. M. Jones*

PHYS. ED. 535. MODERN FOREIGN SYSTEMS OF PHYSICAL EDUCATION (3) Comparative analysis of national and local programs and systems of physical education in foreign countries. Prerequisites: Phys. Ed. 534, 595. *Professor C. M. Speidel*

PHYS. ED. 536. SCIENTIFIC METHODS IN ATHLETIC COACHING (3) Unusual techniques in athletic coaching which are not commonly recognized and used; advanced skills and strategy in coaching major sports. Prerequisite: Phys. Ed. 460. *Professor J. D. Lawther*

PHYS. ED. 550. SEMINAR IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (1-6) Open only to students preparing approved theses and dissertations. *Professor L. M. Jones and Staff*

PHYS. ED. 555. RELATIONSHIPS OF PHYSICAL EDUCATION TO THE EXACT SCIENCES (3) Prerequisite: Phys. Ed. 481. *Professor Mildred Lucey*

PHYS. ED. 560. ADMINISTRATIVE PROBLEMS OF PHYSICAL EDUCATION IN SCHOOLS (3) Solutions to problems emerging from the administration of physical education in schools, fitting physical education into the school's schedule, awards and budgets. Prerequisite: Phys. Ed. 491. *Professor L. M. Jones*

PHYS. ED. 581. PROBLEMS IN BODY MECHANICS (3) Certain aspects of human motion and body segmental alignment; analysis of human gait, and the dynamic adaptation of the spine, thorax, and pelvis to external physical forces. Prerequisites: Health Ed. 244, Phys. Ed. 399. Lecture 3 hours. *Professor Ellen Kelly*

PHYS. ED. 595. PHILOSOPHY OF HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Health Ed. 453 or Phys. Ed. 465 or 491. *Professor L. M. Jones*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PHYS. ED. 424. MODERN TRENDS IN HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS (3) *Professor L. M. Jones*

PHYS. ED. 429S. THE MODERN DANCE IN EDUCATION (3) *Professor Dorothy Briant*

PHYS. ED. 431S. COACHING OF ADVANCED BASEBALL (3) *Professor F. J. Bedenk*

PHYS. ED. 436S. COACHING OF ADVANCED FOOTBALL (3) *Professor F. J. Bedenk*

PHYS. ED. 437S. COACHING OF ADVANCED BASKETBALL (3) *Professor E. A. Gross*

PHYS. ED. 438S. COACHING OF ADVANCED TRACK (3) *Professor C. D. Werner*

PHYS. ED. 439S. COACHING OF ADVANCED SOCCER (3) *Mr. W. Jeffrey*

PHYS. ED. 440S. COACHING OF ADVANCED GYMNASTICS (3) *Professor E. Wettstone*

PHYS. ED. 441S. ADVANCED COACHING OF ATHLETICS FOR MEN (1-11)

Unit A. Basketball (1) *Professor E. A. Gross*

Unit B. Football (1) *Professor F. J. Bedenk*

Unit C. Track and Field (1) *Professor C. D. Werner*

Unit D. Baseball (1) *Professor F. J. Bedenk*

Unit E. Wrestling (1) — *Professor C. M. Speidel*
Unit F. Soccer (1) — *Mr. W. Jeffrey*
Unit G. Swimming (1) — *Mr. W. A. Gutteron*
Unit H. Gymnastics (1) — *Professor E. Wettstone*
Unit I. Boxing (1) — *Mr. L. Houck*
Unit J. Lacrosse (1) — *Professor G. N. Thiel*
Unit K. Fencing (1) — *Professor H. A. Meyer*

PHYS. ED. 449S. ADVANCED TEACHING OF SPORTS AND RHYTHMICS (1-8)
Unit A. Soccer and Speedball (1) — *Professor Mildred Lucey*
Unit B. Basketball (1) — *Professor Mildred Lucey*
Unit C. Field Hockey (1) — *Professor Mildred Lucey*
Unit D. Archery (1) — *Professor Marie Haidt*
Unit E. Swimming (1) — *Miss R. E. Leonard*
Unit F. Rhythmics for Children (1) — *Professor Dorothy Briant*
Unit G. Modern Dance and Accompaniment (1) — *Professor Dorothy Briant*
Unit H. Early American Country Dancing and Social Dancing (1) — *Professor Dorothy Briant*
Unit I. Tennis (1) — *Professor Mildred Lucey*
Unit J. Badminton (1) — *Professor Mildred Lucey*
Unit K. Golf (1) — *Mr. R. B. Rutherford, Jr.*

PHYS. ED. 452S, 452X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE ELEMENTARY SCHOOL (3) — *Professor C. M. Speidel*

PHYS. ED. 453S, 453X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE HIGH SCHOOL (3) — *Professor E. C. Bischoff*

PHYS. ED. 454. THE NATURAL PROGRAM OF PHYSICAL EDUCATION ACTIVITIES, APPLIED (3) — *Professor E. C. Bischoff*

PHYS. ED. 455. SCIENTIFIC METHOD IN HEALTH AND PHYSICAL EDUCATION (3) — *Mr. J. W. Masley*

PHYS. ED. 460. METHODS AND PRINCIPLES OF ATHLETIC COACHING (3) — *Professor J. D. Lawther*

PHYS. ED. 466S. VISUAL INSTRUCTION IN ATHLETICS (3) — *Professor R. M. Conger*

PHYS. ED. 471S. HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS FOR THE SCHOOL ADMINISTRATOR (3) — *Professor L. M. Jones*
Unit A. Athletics in the Schools (1)
Unit B. Health Education in the Schools (1)
Unit C. Physical Education and Recreation in the Schools (1)

PHYS. ED. 480. ADVANCED ANATOMY AND PHYSIOLOGY, APPLIED (3) — *Professor Ellen Kelly*

PHYS. ED. 482, 482X. POSTURE EDUCATION IN THE SCHOOLS (3) — *Professor Ellen Kelly*

PHYS. ED. 488S. THE ADMINISTRATION OF PHYSICAL EDUCATION AND ATHLETICS FOR WOMEN (3) — *Professor Marie Haidt*

PHYS. ED. 489. INTRAMURAL ATHLETICS (3) — *Professor E. C. Bischoff*

PHYS. ED. 490. INTRODUCTORY COURSE IN TESTS AND MEASUREMENTS IN HEALTH AND PHYSICAL EDUCATION (3) — *Professor F. J. Bedenk*

PHYS. ED. 491. ORGANIZATION AND ADMINISTRATION OF HEALTH AND PHYSICAL EDUCATION IN SCHOOLS (3) — *Professor L. M. Jones*

PHYSICS

PROFESSOR HAROLD K. SCHILLING, M.A., Ph.D.
Head of the Department

PHYS. 501a,b,c,d,e. PHYSICS RESEARCH (1-15 per semester) Original work to obtain material for a thesis. May be continued in successive semesters as Phys. 501b, 501c, etc. to a maximum of 45 credits.

PHYS. 507. THEORETICAL THERMODYNAMICS (3) A mathematical treatment of the principles of thermodynamics. Lecture 3 hours.

PHYS. 509. PHYSICS SEMINAR (1) Selected topics from current physical research critically examined and discussed. May be continued in successive semesters as Phys. 509a, 509b, 509c. Seminar.

PHYS. 517. KINETIC THEORY (3) The Maxwell-Boltzmann law, Brownian movements, specific heats, and other selected topics. Prerequisites: Phys. 411, Math. 431. Lecture 3 hours.

PHYS. 521. CRYSTAL STRUCTURE (3) The solution of the structure of crystals by X-ray methods. Lecture 3 hours. Available for major credit in either physics or chemistry.

PHYS. 522. ADVANCED CRYSTAL ANALYSIS (3) Continuation of Phys. 521, including the application of crystal structure studies to physical, chemical, and metallurgical problems. Available for major credit in either physics or chemistry. Lecture 3 hours.

PHYS. 530. INTRODUCTION TO THEORETICAL PHYSICS (3) The application of higher mathematics to problems in the various fields of physics. Prerequisites: Math. 431, Phys. 285. Lecture 3 hours.

PHYS. 531. THEORETICAL PHYSICS (3) Continuation of Phys. 530.

PHYS. 533. THEORY OF SOUND (3) Mathematical treatment of the theory of sound. Prerequisite: Phys. 530. Lecture 3 hours.

PHYS. 551. ADVANCED ELECTRON THEORY (1-3) Properties of matter in terms of modern electron theory. Prerequisite: Phys. 531. Lecture 1 to 3 hours.

PHYS. 553. NUCLEAR PHYSICS (3) Mathematical course in nuclear physics. Prerequisite: Phys. 562. Lecture 3 hours.

PHYS. 557. ELECTRICITY AND MAGNETISM (3) A treatment of the mathematical theory of electricity and magnetism. Prerequisite: Phys. 467. Lecture 3 hours.

PHYS. 558. ELECTRICITY AND MAGNETISM (3) Continuation of Phys. 557. Prerequisite: Phys. 557. Lecture 3 hours.

PHYS. 559. PHYSICAL OPTICS (3) Advanced study of the physical properties of light. Prerequisite: Phys. 459. Lecture 3 hours.

PHYS. 560. ADVANCED PHYSICAL MEASUREMENTS (1-18) Offers opportunity for advanced work in the various fields of physics.

PHYS. 561. DE BROGLIE WAVES AND QUANTUM MECHANICS (3) An introduction to the modern interpretation of atomic structure and radiation phenomena, based upon the de Broglie and Schroedinger wave theory. Prerequisite: Phys. 531. Lecture 3 hours.

PHYS. 562. WAVE MECHANICS IN MODERN PHYSICS (3) This continuation of Phys. 561 discusses the theory of atomic and simple molecular spectra, Zeeman and Stark effect, theories of metallic conductivity and thermionic emission, etc. Prerequisite: Phys. 561. Lecture 3 hours.

PHYS. 571. ATOMIC STRUCTURE (3) Recent work in atomic and subatomic physics. Lecture 3 hours.

PHYS. 572. SPECTROSCOPY (3) Atomic and molecular spectra, both emission and absorption methods of excitation, radiation and ionization potentials, spectral series, fine structure, spectra of ionized and stripped atoms. Lecture 3 hours.

PHYS. 575. PROBLEMS IN MODERN PHYSICS (1-3) Theoretical studies in any field of modern physics with or without associated experimental work. Prerequisite: Phys. 455.

PHYS. 577. CLASSICAL MECHANICS (3) The principles and applications of classical mechanics. Prerequisite: Phys. 461. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PHYS. 401. ELECTRONICS (3)
PHYS. 403. VACUUM TUBE CIRCUITS (3)
PHYS. 404. MEASUREMENTS EMPLOYING VACUUM TUBES (2-4)
PHYS. 411. THEORETICAL MECHANICS (3)
PHYS. 433S. INTERMEDIATE MECHANICS AND FLUID PHYSICS (3)
PHYS. 435S. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
PHYS. 437S. INTERMEDIATE HEAT, SOUND, AND LIGHT (3)
PHYS. 439S. ELEMENTARY SURVEY OF MODERN PHYSICS (3)
PHYS. 443. INTERMEDIATE ACOUSTICS (3)
PHYS. 444. MEASUREMENTS IN ACOUSTICS (2)
PHYS. 451. ELECTRONICS AND IONICS (3)
PHYS. 452. ELECTRONIC MEASUREMENTS (2-4)
PHYS. 453. ELECTRON OPTICS AND POSITIVE ION BEAMS (3)
PHYS. 455. SURVEY OF MODERN PHYSICS (3)
PHYS. 459. INTERMEDIATE OPTICS (3)
PHYS. 460. INTERMEDIATE LABORATORY OPTICS (2-4)
PHYS. 461. THEORETICAL MECHANICS (3)
PHYS. 463. RADIOACTIVITY AND NUCLEAR PHYSICS (3)
PHYS. 467. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
PHYS. 468. ADVANCED ELECTRICAL MEASUREMENT (2)
PHYS. 480. GLASS WORKING AND LABORATORY TECHNIQUES (1-3)

PHYS. 486. ASTRONOMICAL PHOTOGRAPHY (3-6)
PHYS. 490. MODERN STELLAR THEORY (3-9)
PHYS. 491S. ADVANCED CELESTIAL MEASUREMENTS (3-9)

POLITICAL SCIENCE

PROFESSOR M. NELSON MCGEARY, M.A., Ph.D.
Head of the Department

POL. SCI. 500. SEMINAR IN POLITICAL SCIENCE (3-12) Subject to be announced.

POL. SCI. 505. SEMINAR IN ADVANCED AMERICAN GOVERNMENT (3-12)

POL. SCI. 508. RESEARCH IN PUBLIC ADMINISTRATION (3-12)

POL. SCI. 510. POLITICAL AND ADMINISTRATIVE PROBLEMS IN PENNSYLVANIA (3-6) Lecture 3 hours.

POL. SCI. 512. COMPARATIVE GOVERNMENT (3-12)

POL. SCI. 515. INTERNATIONAL RELATIONS (3-6) Current international relations and problems as they appear in the application of the Monroe Doctrine, the work of international organizations, and the programs of nationalism and internationalism. Lecture 3 hours.

POL. SCI. 516. INTERNATIONAL LAW (3-6)

POL. SCI. 517. INTERNATIONAL ORGANIZATION (3-6)

POL. SCI. 519. PUBLIC ADMINISTRATION (3-6)

POL. SCI. 520. ADMINISTRATIVE LAW (3-6) The law dealing with public officers and their procedure; the scope and limits of administrative powers; remedies against illegal government acts. Lecture 3 to 6 hours.

POL. SCI. 521. POLITICAL THEORY (3-6)

POL. SCI. 525. POLITICAL PARTIES (3-6)

POL. SCI. 526. PUBLIC OPINION AND PROPAGANDA (3-6)

POL. SCI. 533. LABOR AND WELFARE LEGISLATION (3-6)

POL. SCI. 535. GOVERNMENT REGULATION (3-6)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

POL. SCI. 411. AMERICAN POLITICAL THEORY (3)
POL. SCI. 413. GOVERNMENT AND FOREIGN POLICY OF THE SOVIET UNION (3)
POL. SCI. 415. INTERNATIONAL ORGANIZATION (3)
POL. SCI. 416. INTERNATIONAL LAW (3)
POL. SCI. 417. MUNICIPAL GOVERNMENT (3)

Pol. Sci. 419. Public Administration (3)
Pol. Sci. 420. Public Personnel (3)
Pol. Sci. 421. Modern Political Theories (3)
Pol. Sci. 424. State Government in the United States (3)
Pol. Sci. 427. Public Opinion and Propaganda (3)
Pol. Sci. 428. Pennsylvania Local Government (3)
Pol. Sci. 429. Pennsylvania Local Administration (3)
Pol. Sci. 431. Ancient and Medieval Political Theories (3)
Pol. Sci. 432. Current Political Trends and Problems in the United States (3-9)
Pol. Sci. 433. Labor and Welfare Legislation and Administrative Problems (3)
Pol. Sci. 435. Government Housing, Planning, and Public Works (3)
Pol. Sci. 442. American Foreign Policy (3)
Pol. Sci. 444. Government Regulation (3)
Pol. Sci. 445. Administrative Law (3)
Pol. Sci. 446. Judicial Systems (3)
Pol. Sci. 450. Government and Foreign Policies of Britain and the Commonwealth (3)
Pol. Sci. 452. Governments and Foreign Policies of Western Europe (3)
Pol. Sci. 454. Governments and Foreign Policies of Eastern Europe (3)
Pol. Sci. 456. Governments and Foreign Policies of Latin America (3)
Pol. Sci. 458. Governments and Foreign Policies of the Far East (3)

PORTUGUESE

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

Port. 571. Seminar in Portuguese Literature (3-6) Prerequisite: Port. 4.

POULTRY HUSBANDRY

Professor Ernest W. Callenbach, M.S.
Head of the Department

P.H. 502. Advanced Poultry Nutrition (2-4) Prerequisite: P.H. 3.
Professor R. R. Murphy

P.H. 503. Advanced Poultry Farm Management (2-4) Prerequisite: P.H. 8.
Professor E. W. Callenbach

P.H. 504. Advanced Market Poultry and Eggs (2-4) Prerequisite: P.H. 7.
Professor P. H. Margolf

P.H. 505. Research in Poultry Husbandry (3-10) Prerequisite: 9 credits in poultry husbandry.
Professor E. W. Callenbach

P.H. 506. Seminar in Poultry Husbandry (1-6)
Professor E. W. Callenbach and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

P.H. 412. Poultry Breeding (3) *Professor A. J. G. Maw*

PSYCHOLOGY

Professor Bruce V. Moore, M.A., Ph.D.
Head of the Department

Psy. 500. Seminar: Introduction to Research Methods (1) Prerequisite: 12 credits in psychology. Lecture 1 hour.

Psy. 501. Advanced Psychology (2-4) A comprehensive study of general psychology. Prerequisite: 9 credits in psychology. *Professor W. M. Lepley*

Psy. 502. Advanced Educational Psychology (2-4) Psychological theories and principles underlying educational theories and practices. Prerequisites: Psy. 14 or 414; Ed. 31 or teaching experience. *Professor E. B. van Ormer*

Psy. 503. Physiological Psychology (2-4) Correlations between structure and function of nervous system and human consciousness; laws and theories in fields of sensation, attention, association, affection, and thought. Prerequisite: 9 credits in psychology. *Professor J. E. DeCamp*

Psy. 504. Comparative Psychology (2-4) Behavior from standpoint of phylogenetic growth and development; biological implications; comparison of different types of animals, including man. Prerequisite: 9 credits in psychology.
Professor C. R. Carpenter

Psy. 505. Research Problems in Psychology (1-15) Prerequisite: 12 credits in psychology.

Psy. 506. Clinical Psychology (1-6) Procedures used in the Psychology Clinic. Limited to students enrolled in Psy. 560. Prerequisites: Ed. 70 or Psy. 471; Psy. 550 or 551. *Professor W. U. Snyder*

Psy. 509. Advanced Theory of Learning and Habit Formation (2) Critical evaluation of the major theories of learning: Hull, Guthrie, Tolman, Lewin. Application of learning theory to major problems in psychology. Prerequisite: Psy. 4 or 407 or 414. Lecture 2 hours. *Professor J. H. Grosslight*

Psy. 510. History of Psychology (2-4) The theoretical systems, experiments, and personalities in the development of modern psychology until about 1920. Prerequisite: 9 credits in psychology. *Professor C. R. Carpenter*

Psy. 511. Contemporary American Psychology (2) Current systems or schools

of psychology with comparative study and critical analysis; points of view as presented by recognized leaders. Prerequisite: Psy. 510. *Professor W. M. Lepley*

Psy. 513. Educational Psychology: Differential (2) Causes of differences in achievement and personality; psychological implications of the methods used by schools in adjusting to individual differences. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor E. B. van Ormer*

Psy. 514. Educational Psychology: Learning (2) Experimentally determined facts about the learning process; synthesis of main theories of learning; application of principles related to: motivation, practice, retention, transfer, meaning, and problem solving. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. Lecture 2 hours. *Professor E. B. van Ormer*

Psy. 515. Advanced Statistics in Psychology and Education (3) Sampling, tests of significance, factor analysis, analysis of variance and other advanced statistical methods; the application of statistical methods to practical problems. Prerequisite: Psy. 415 or Ed. 574. Recitation 3 hours. *Professor A. K. Kurtz*

Psy. 517. Psychology of Attitudes and Opinions (3) Acquisition and control of attitudes and opinions, including beliefs, convictions, biases, prejudices, and ideologies as determinants of action. Prerequisite: 18 hours in psychology, including Psy. 417, 422, 437. *Professor C. R. Carpenter*

Psy. 521. Research Problems in Industrial Psychology (2-6) Actual industrial personnel problems in laboratory and industrial plants: monotony, fatigue, psychological selection, and training procedures. Prerequisites: Psy. 21 or 421; 431. *Professor Kinsley R. Smith*

Psy. 522. Advanced Psychological Marketing Research Techniques (3-6) Technical aspects of sampling; construction, tabulation, and interpretation of questionnaires to test consumer reaction to products, advertising, and company policies. Prerequisite: 15 credits in psychology, including Psy. 15, 21, 422. Lecture 2 to 4 hours, practicum 1 to 2 hours. *Professor L. P. Guest*

Psy. 528. Opinion Research Administration (3-6) Practicum in the planning, development of techniques, and administration of the sample survey. Prerequisites: Psy. 422, 428. Practicum 9 to 18 hours. *Professor L. P. Guest*

Psy. 540. Clinical Psychology Seminar (1-6) Seminar on current problems in clinical psychology. Prerequisite: Psy. 482.

Psy. 541. Dynamics of Human Adjustment (3) Seminar on motivation of human behavior, frustration, and mechanisms of adjustment; normal behavior is stressed. Prerequisite: Psy. 437. *Professor R. G. Bernreuter*

Psy. 542. Psychopathology (3) Covers basic, developmental, human, experimental reactions, showing how normal and pathological character trends and deviations evolve; basic reasons for and applications of psychotherapeutic methods. Prerequisite: Psy. 412 or 437. *Professor G. M. Lott*

Psy. 543. Counseling Techniques (2) Survey of psychotherapeutic methods: history, theory, and methods employed; case illustrations. Prerequisite: Psy. 482. Seminar 2 hours. *Professor W. U. Snyder*

Psy. 550. Psychometrics: Binet (2) Measurement of intelligence by Stanford revision of the Binet-Simon technique; demonstrations, lectures; practice administering tests; observations of student by instructor. Prerequisite: Psy. 471.

Psy. 551. Psychometrics: Point Scales (2) Measurement of intelligence by individual nonverbal techniques: Arthur, Wechsler-Bellevue, and others; demonstrations, lectures, and practice administering tests under observation. Prerequisite: Psy. 471.

Psy. 552. Psychometrics: Preschool (2) Measurement by individual preschool scales: Merrill-Palmer, Minnesota, California First Year; demonstrations, lectures, and practice in administering tests under observation. Prerequisite: Psy. 551. Lecture 1 hour, practicum 2 hours.

Psy. 553. Psychometrics: Advanced (2) Measurement of intelligence, social maturity, and other characteristics; demonstration, lectures, and practice in administering tests; observations by instructor. Prerequisite: Psy. 550.
Professor R. G. Bernreuter

Psy. 554. Psychometrics: Sensory (2-3) Measurement of auditory and visual acuity and defects; psychophysiological theory; demonstrations, lectures, and practice in administering and interpreting tests under observation. Prerequisite: Psy. 4. Lecture 1 or 2 hours, practicum 2 hours.

Psy. 555. Psychometrics: Projective (3) Principles and methods of using and evaluating projective techniques, with particular attention to Rorschach. Prerequisite: Psy. 550. Lecture 2 hours, practicum 2 hours.

Psy. 556. Psychometrics: Advanced Projective (3) Continuation of Psy. 555, with attention to other projective techniques: Thematic Apperception, play, dramatics; and further consideration of Rorschach. Prerequisite: Psy. 555. Lecture 2 hours, practicum 2 hours.

Psy. 560. Clinical Practicum (2-3) Applied experience in techniques of clinical psychology; case work in Psychology Clinic. Prerequisites: Psy. 471, 482, 550, 551. Practicum 3 hours per credit.

Psy. 561. Clinical Practicum: Elementary School (1-3) Experience in the Psychology Clinic and public schools in learning and adjustment problems; diagnosis and remedial work; pertinent school laws and practices. Prerequisites: Psy. 560 and Ed. 70, or Ed. 432g or 470.

Psy. 562. Clinical Practicum: Vocational Guidance (1-3) Practical experience in the Psychology Clinic on high school, college, and adult vocational guidance cases; staff meetings; seminar on techniques and materials. Prerequisites: Psy. 560 or Ed. 453, Ed. 474 and Psy. 472.

Psy. 563. Clinical Practicum: Marital Counseling (1-3) Experience in the

Psychology Clinic on premarital and marital adjustment; seminar on techniques of adjustment and development of sexual and emotional maturity in marriage. Prerequisite: Psy. 560. *Professor C. R. Adams*

Psy. 564. Clinical Practicum: Personal Adjustment Counseling (2-3) Advanced practicum with experience in counseling of personal adjustment problems referred to the Psychology Clinic. Prerequisite: Psy. 565. Practicum 3 hours per credit. *Professor W. U. Snyder*

Psy. 565. Clinical Practicum: Nondirective Counseling (3) Practical experience in application of the nondirective method, along with systematic theoretical study of the method. Prerequisites: Psy. 543, 560. Lecture 2 hours, practicum 3 hours. *Professor W. U. Snyder*

Psy. 566. Clinical Practicum: Hypnotherapy (1-3) Practical experience in the Psychology Clinic in the use of hypnotherapy; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

Psy. 567. Clinical Practicum: Play Therapy (1-3) Practical experience in the Psychology Clinic in the use of play therapy with young children; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

Psy. 568. Clinical Practicum: Group Therapy (2) Practical experience in the Psychology Clinic in the use of group methods for the treatment of personal maladjustments; staff meetings; seminar on principles and techniques. Prerequisite: Psy. 565.

Psy. 574. Mental Deficiency (3) Causes of mental deficiency; diagnosis, training, and care of mental defectives. Prerequisites: Psy. 414 or 482.

Psy. 590. Seminar: Advanced (1-4) Prerequisite: Psy. 500.

Psy. 599. Thesis (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Psy. 400. Honors Course in Psychology (2-6)

Psy. 407. Intermediate Experimental Psychology (3) *Professor W. M. Lepley*

Psy. 409. Psychobiology (3) *Professor C. R. Carpenter*

Psy. 411, 411X. Psychology of the Preschool Child (3) *Professors E. B. van Ormer, D. G. Thevaos*

Psy. 412, 412X. Abnormal Psychology (3) *Professor J. E. DeCamp*

Psy. 414, 414X. Intermediate Educational Psychology (2-3) *Professors E. B. van Ormer, D. G. Thevaos*

Psy. 415, 415X. Intermediate Statistics in Psychology and Education (3) *Professor A. K. Kurtz*

Psy. 417. Social Psychology (2-3) *Professor C. R. Carpenter*

Psy. 418. Measurement of Personality (2-3) *Professor R. G. Bernreuter*

Psy. 419. Guidance and Education in Sexual and Marital Adjustment (3) *Professor C. R. Adams*

Psy. 420. Applied Social Psychology (3) *Professors C. R. Carpenter, Kinsley R. Smith*

PSY. 421, 421X. ADVANCED APPLIED PSYCHOLOGY (3) *Professor Kinsley R. Smith*
PSY. 422. PSYCHOLOGICAL METHODS OF MEASURING THE REACTIONS OF THE PUBLIC (3) *Professor L. P. Guest*
PSY. 423. TEST CONSTRUCTION AND STANDARDIZATION (2-3) *Professor A. K. Kurtz*
PSY. 424. PSYCHOLOGICAL TECHNIQUES IN PUBLIC PERSONNEL ADMINISTRATION (3) *Professor C. R. Adams*
PSY. 425, 425X. PSYCHOLOGY OF THE ELEMENTARY SCHOOL CHILD (2-3) *Professor E. B. van Ormer*
PSY. 426, 426X. ADOLESCENCE (2-3) *Professors E. B. van Ormer, D. G. Thevaos*
PSY. 427. PSYCHOLOGICAL PRINCIPLES IN ADVERTISING (3) *Professor L. P. Guest*
PSY. 428. OPINION RESEARCH LABORATORY (3) *Professor L. P. Guest*
PSY. 431, 431X. INDUSTRIAL PSYCHOLOGY (3) *Professor Kinsley R. Smith*
PSY. 437, 437X. ADVANCED PSYCHOLOGY OF ADJUSTMENT AND MENTAL HYGIENE (3) *Professors J. H. Grosslight, W. U. Snyder*
PSY. 438. THEORY OF PERSONALITY (3) *Professor J. H. Grosslight*
PSY. 439. MOTIVATION AND EMOTION (3) *Professor Kendon R. Smith*
PSY. 440. PSYCHOLOGY PROJECTS (1-6)
PSY. 471, 471X. MEASUREMENT OF INTELLIGENCE (2) *Professor R. G. Bernreuter*
PSY. 472. SPECIAL ABILITY TESTING (2) *Professor B. V. Moore*
PSY. 482. INTRODUCTION TO CLINICAL PSYCHOLOGY (3) *Professor W. U. Snyder*

PUBLIC UTILITIES

PROFESSOR ERIC A. WALKER, M.S., Sc.D.
Head of the Department of Electrical Engineering

PUB. UTIL. 521. PUBLIC UTILITIES (3) Problems of current interest in the public utility field, principally those utilities involving the use of the principles of electrical engineering. One or two conferences per week. *Professor A. P. Powell*

In addition to this course the following may be taken for graduate credit under the restrictions in force:

PUB. UTIL. 421. ELECTRIC UTILITIES (3) *Professor A. P. Powell*

RECREATION

Consult PROFESSOR FRED M. COOMBS, M.A.

REC. 510. PROGRAM FOR THE SUMMER CAMP (3) Prerequisites: Rec. 430 and experience as a camp counselor or director. *Professor F. M. Coombs*

REC. 533. RECREATION STUDIES, SURVEYS, AND APPRAISALS (3) Types, purposes, and methods of conducting recreation studies and surveys; procedures on the appraisal of community recreation. Prerequisite: Phys. Ed. 530. Lecture 3 hours. *Professor F. M. Coombs*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

REC. 430. INTRODUCTION TO ORGANIZED CAMPING (3) *Professor F. M. Coombs*
Unit A. Scope, Significance, and Leadership (1)
Unit B. Facilities, Equipment, and Organization of Activities (1)
Unit C. Administrative Procedures (1)
REC. 432. RECREATION IN INDUSTRY (3) *Professor J. B. Kessel*
REC. 433. ANALYSIS OF RECREATIONAL METHODS (3) *Professor J. B. Kessel*
REC. 435. ORGANIZATION AND ADMINISTRATION OF OUTDOOR RECREATION (1 per unit) *Professor F. M. Coombs*
Unit A. Administrative Procedure and Policies (1)
Unit B. Conduct of the Program (1)
Unit C. Facilities, Equipment, and Finances (1)
REC. 456. SOCIAL RECREATION (3) *Professor J. B. Kessel*
REC. 461, 461X. PROGRAMS OF COMMUNITY RECREATION (1 per unit) *Professor F. M. Coombs*
Unit A. Programs of the Rural Community (1)
Unit B. Programs of the Urban Community (1)
Unit C. Programs of Large Municipalities (1)
REC. 462. RECREATION FOR THE HANDICAPPED (3) *Professor C. M. Speidel*
REC. 463. RECREATION LAW (3) *Professor J. B. Kessel*
REC. 465, 465X. ADMINISTRATION OF RECREATION (3) *Professor F. M. Coombs*

*RURAL SOCIOLOGY

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.
Head of the Department of Agricultural Economics and Rural Sociology

RUR. SOC. 551. RURAL SOCIOLOGY SEMINAR (1-6) Prerequisite: 6 credits in rural sociology, sociology, or psychology. Lecture 3 hours.

RUR. SOC. 552. THE STRUCTURE OF RURAL SOCIETY (3) Systematic review of research dealing with the structure of rural society; the purpose, methodology, and contribution of each study treated. Prerequisites: Rur. Soc. 11, Soc. 1. Recitation 3 hours.

RUR. SOC. 553. RURAL SOCIAL PROCESSES (3) Continuation of Rur. Soc. 552. The functioning of rural society; research dealing with the subject reviewed and evaluated. Prerequisites: Rur. Soc. 11, 552. Recitation 3 hours.

RUR. SOC. 554. ADVANCED RURAL SOCIAL WELFARE (3) Analysis of welfare techniques and their application to rural situations. Prerequisites: Rur. Soc. 11; Psy. 2 or Rur. Soc. 459. Recitation 3 hours. *Professor W. G. Mather*

RUR. SOC. 555. THE RURAL CHURCH (3) The rural church as a social institution;

* Credit in rural sociology will also be given for Agr. Ec. 505 and 525.

its relation to the community; the church in "problem" areas; effects of population trends on the program of the rural church; the use of case studies and surveys. Prerequisite: 6 credits in rural sociology, sociology, or psychology. Recitation 3 hours. *Professor W. G. Mather*

RUR. SOC. 556. THESIS IN RURAL SOCIOLOGY (6) A preparation of the required thesis for the degree of Master of Science in rural sociology while in residence at the College.

RUR. SOC. 557. THE DEVELOPMENT OF THE RURAL COMMUNITY (3) The origin and evolution of the rural community under different geographic and cultural conditions. Prerequisites: Rur. Soc. 11 or Soc. 1; Rur. Soc. 452 or Soc. 415a. Recitation 3 hours. *Professor W. G. Mather*

RUR. SOC. 559. ADVANCED RURAL SOCIAL PSYCHOLOGY (3) The application of social psychological principles to the treatment of rural problems. Prerequisites: Rur. Soc. 11, Psy. 2. Recitation 3 hours. *Professor M. E. John*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

RUR. SOC. 452. RURAL ORGANIZATION (3)
RUR. SOC. 454. RURAL SOCIAL WELFARE (3) *Professor W. G. Mather*
RUR. SOC. 456. RURAL STANDARDS OF LIVING (3) *Professor W. G. Mather*
RUR. SOC. 459. RURAL SOCIAL PSYCHOLOGY (3) *Professor M. E. John*

SOCIOLOGY

PROFESSOR SETH W. RUSSELL, M.A., Ph.D.
Head of the Department

SOC. 502. AMERICAN SOCIOLOGY (3) Special problems in sociological theory in the United States. Prerequisite: Soc. 402. Recitation 3 hours.
Professor L. L. Bernard

SOC. 503. PROBLEMS OF SOCIAL PSYCHOLOGY (3-9) Investigation of the theories, methods, and empirical data of social psychology, with particular reference to such problems as the relations between personality and culture, social and personal disorganization, the development of role behavior, and the conception of the self. *Professor W. Coutu*

SOC. 504. SOCIOLOGY OF KNOWLEDGE (3) The social psychology of knowing; selective bases of judgments about reality; relation of knowledge to bias, experience, styles of thinking. Prerequisites: Soc. 400 or 401; 418, 425. *Professor W. Coutu*

SOC. 510. FIELD WORK IN SOCIOLOGY (1-3) Advanced research projects to be carried out in the field under the supervision of the department and recognized social agencies.

SOC. 512. MODERN CRIMINOLOGY (3) *Professor R. E. Clark*

Soc. 513. Advanced Sociological Research Methods and Techniques (3) Special problems in scientific method and research techniques; designed to prepare the student for social inquiry on a professional level; embraces both quantitative and nonquantitative type of work. Prerequisites: Soc. 413 and 3 credits of statistics. *Professor M. E. John*

Soc. 515. Structure and Functions of the Community (3) *Professor Jessie Bernard*

Soc. 516. Sociological Theory (3) *Professor L. L. Bernard*

Soc. 519. Seminar in Race Relations (3-6) The status and problems of minority peoples in selected areas of the world; analysis of the material, social, and socio-psychic aspects of race relations presented in lectures, reports, and papers. Lecture 3 hours.

Soc. 523. Advanced Research in Population (3) Supervised original research on some aspect of demographic phenomena and vital statistics; a genuine contribution to knowledge is expected of the student. *Professor O. D. Duncan*

Soc. 525. Seminar in Sociology (1-9) An advanced seminar in sociological theory, involving intensive study of the works of several eminent authors. The list of social theorists dealt with varies from one semester to another, but only those are selected who have made fundamental contributions to the analysis of social structure, social interaction, and social change.

Soc. 530. Research on Marriage and the Family (3) Training in methods and techniques of research in family relations. Under the guidance of the instructor, experimental, statistical, and comparative studies are carried out, individually or co-operatively. Prerequisites: graduate standing and 3 hours' previous work in this field. Lecture 3 hours. *Professor Jessie Bernard*

Soc. 534. Problems in Social Control (3-12) An advanced seminar dealing with the cohesive factors in societies and groups. Differentiates the forms and the instrumentalities of social control, traces their development in different periods, and attempts a systematic explanation of them, utilizing experimental and quantitative approaches where applicable. *Professor L. L. Bernard*

Soc. 540. Anthropological Theory (3) A seminar in which major anthropological concepts and theories are critically studied. Anthropological theories are tested by the use of empirical ethnological material.

Soc. 561. Seminar in Sociology of Religion (3) Prerequisites: Soc. 60 or 61; 415 or 418; 400 or 401. *Professors L. L. Bernard, S. W. Russell*

Soc. 572. Methods of Sampling (3) Application of sampling techniques to the field of sociological research. Prerequisite: Soc. 471. *Professor R. E. Clark*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Soc. 400. Sociological Theory (3) *Professors L. L. Bernard, S. W. Blizzard, Jr.*
Soc. 401. Social Institutions (3) *Professor S. W. Russell*

Soc. 402. American Sociology (3) *Professor L. L. Bernard*
Soc. 403a. Personality and Social Adjustment (3) *Professor W. Coutu*
Soc. 403b. Personality and Social Adjustment (3) *Professor W. Coutu*
Soc. 405S. Social Problems (3)
Soc. 408. Social Ecology (3) *Professor S. W. Blizzard, Jr.*
Soc. 413. Methods and Techniques of Social Research (1-6)
Professor Jessie Bernard
Soc. 415a. Community Institutions (3) *Professor Jessie Bernard*
Soc. 418. The Development of Social Thought (3)
Soc. 419. Minority Peoples (3)
Soc. 423. Population Research (3) *Professor O. D. Duncan*
Soc. 424. Social Change (3)
Soc. 425. Contemporary Sociological Theory (3) *Professor L. L. Bernard*
Soc. 426. Introduction to Public Welfare (3) *Professor W. G. Mather*
Soc. 427S. Family Case Work (6)
Soc. 429. Social Stratification (3)
Soc. 431. Mass Entertainment (3)
Soc. 435. Social Control (3)
Soc. 440. Primitive Society (3)
Soc. 461. Sociology of Religion (3)
Soc. 470. The Use of Statistics in Sociology (3) *Professor R. E. Clark*
Soc. 471. Advanced Sociological Statistics (3)

SPANISH

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

Sp. 544. Neo-Classicism in the Romance Literatures (3) The nature and development of the Neo-classic movement in Italy, France, Spain, and Portugal. Prerequisite: Sp. 40. Lecture 3 hours.

Sp. 545. Romanticism in the Romance Literatures (3) The nature and development of the Romantic movement in Italy, France, Spain, and Portugal. Prerequisite: Sp. 40. Lecture 3 hours.

Sp. 546. Medieval Romance Literatures (3) The nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal. Prerequisite: Sp. 40. Lecture 3 hours.

Sp. 547. Realism, With Particular Reference to Romance Literature (3) Prerequisite: Sp. 4. Lecture 3 hours.

Sp. 548. 20th Century Romance Literature as a Political Force (3) Prerequisite: Sp. 4. Lecture 3 hours.

Sp. 551. Romance Philology (3) Historical development of the Romance languages. Recitation 3 hours.

Sp. 552. Old Spanish Readings (3) Familiarizes the student with Old Spanish texts. Prerequisite: Sp. 551. Recitation 3 hours.

Sp. 561. Spanish Drama Previous to Lope de Vega (3) Origin and early development of the Spanish national drama. Representative plays of different types will be read and discussed. Lectures and reports. Recitation 3 hours.

Sp. 562. Spanish Drama Previous to Lope de Vega (3) Continuation of Sp. 561. Recitation 3 hours.

Sp. 565. Lope de Vega (3)

Sp. 566. Lope de Vega's Followers (3)

Sp. 567. Cervantes and His Works (3)

Sp. 568. Cervantes and His Works (3)

Sp. 571. Seminar in Spanish Literature (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

Sp. 572. Seminar in Spanish Literature (3) Continuation of Sp. 571. Recitation 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Sp. 401. The Golden Age (3)
Sp. 402. Drama of the Golden Age (3)
Sp. 403. Don Quixote (3)
Sp. 404. Old Spanish Language and Literature (3)
Sp. 405. Spanish Drama of the 19th Century (3)
Sp. 406. Contemporary Spanish Drama (3)
Sp. 407. The Spanish Novel of the 19th Century (3)
Sp. 408. The Contemporary Spanish Novel (3)
Sp. 409, 409X. Introduction to Latin-American Literature (3)
Sp. 410. Introduction to Latin-American Literature (3)
Sp. 411. Mexico: Its Language and Literature (3)
Sp. 412. Argentina: Its Language and Literature (3)
Sp. 415. Modern Spanish Lyric Poetry (3)
Sp. 417. Spanish Literature in the Romantic Period (3)
Sp. 421. The Teaching of Romance Languages (3)
Sp. 490. Advanced Composition (3)
Sp. 496. Literary Criticism in France, Italy, and Spain (3)

SPEECH

Professor Robert T. Oliver, M.A., Ph.D.
Head of the Department

Speech 500. Seminar in American Oratory (2-4) The history of American ora-

tory, with the application of critical standards to the work of specific orators. Prerequisite: 6 credits in speech, including Speech 200. *Professor J. F. O'Brien*

SPEECH 510. SEMINAR IN METHODS OF TEACHING SPEECH (2-4) Problems in curriculum construction, media, and methods as met by the high school and college teacher of speech. Consideration of speech as a unit of English, as a distinct discipline, and as an extracurricular activity. Prerequisite: 6 credits in speech, including Speech 200. *Professor J. F. O'Brien*

SPEECH 520. SEMINAR IN SPEECH SCIENCE (2-4) A seminar in the physical and physiological bases of speech and voice; introduction to the laboratory techniques used in speech research. Prerequisite: 9 credits in speech, speech education, or psychology.

SPEECH 525. SEMINAR IN CLINICAL SPEECH PATHOLOGY (2-4) A physiological, neurological, and psychological view of the speech process together with a critical study of modern theories and practices in clinical speech pathology. Prerequisites: Speech 490, 491.

SPEECH 540. SEMINAR IN THE PROBLEMS OF RADIO (3) Advanced study and research in special problems in radio speech, radio production, and radio organization. Prerequisite: 6 hours of speech including Speech 200, 300, 425 or 435. Lecture 1 hour, recitation 2 hours. *Professor H. E. Nelson*

SPEECH 550. SEMINAR IN ORAL PERSUASION (2-4) The theory of persuasion; persuasive devices and techniques; criticism and appreciation of men of political, economic, and social movements, and of contemporary public address in the light of modern theories of persuasion. Prerequisite: 6 credits in speech, including Speech 200. *Professor C. H. Schug*

SPEECH 560. PUBLIC ADDRESS (2-4) Aids the student in becoming proficient in public platform address; emphasis on practical application of principles of persuasion, especially through composition, discussion, criticism, and delivery of the speech outline and manuscript. Prerequisite: 9 credits in speech, including Speech 200 and 550. *Professor C. H. Schug*

SPEECH 575. RESEARCH PROBLEMS IN SPEECH (1-12) Advanced research on an individual basis in oratorical criticism, discussion techniques, persuasion, pedagogy, phonetics, speech science, and speech pathology. Prerequisite: 12 credits in speech or in speech education.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

SPEECH 400. TEACHING OF SPEECH (3) *Professor J. F. O'Brien*
SPEECH 405a,b,cS. PRACTICAL PROBLEMS IN PUBLIC AND PRIVATE SPEECH (1-3)
SPEECH 410. ENGLISH PHONETICS AND PRONUNCIATION (3) *Professor J. F. O'Brien*
SPEECH 411a,b,cS. SPEECH SCIENCE AND SPEECH ARTS (1-3)
SPEECH 412. ADVANCED SPEECH ARTS (3)
SPEECH 425. ADVANCED PRINCIPLES OF RADIO SPEECH (3) *Professor H. E. Nelson*
SPEECH 431. ANATOMY AND PHYSIOLOGY OF THE EAR AND VOCAL MECHANISMS (3)

SPEECH 435. RADIO ORGANIZATION (3) *Professor H. E. Nelson*
SPEECH 450. DISCUSSION TECHNIQUES (3) *Professor J. F. O'Brien*
SPEECH 490. SPEECH DISORDERS AND THEIR TREATMENT (3) *Professor E. T. McDonald*
SPEECH 491. CLINICAL SPEECH PRACTICUM (1-3) *Professor E. T. McDonald*

SPEECH EDUCATION

Consult PROFESSOR EUGENE T. MCDONALD, M.Ed., D.Ed.

SPEECH ED. 537. ADVANCED SPEECH CORRECTION (1-6) The clinical speech procedures of examination, diagnosis, and treatment. Prerequisite: Speech Ed. 437 or Speech 491. Lecture and practicum hours 1 to 6. *Professor E. T. McDonald*

SPEECH ED. 540. ARTICULATION DISABILITIES (3) Speech-sound production disorders in children and adults; methods of examination, diagnosis, and treatment. Prerequisite: Speech 490 or Speech Ed. 436.

SPEECH ED. 541. THE VOICE AND ITS DISORDERS (3) Physical, physiological, and psychological bases of voice production; causes, nature, and symptoms of its disorders; current clinical methods in voice improvement. Prerequisite: Speech Ed. 436 or Speech 490. Lecture 3 hours.

SPEECH ED. 542. STUTTERING AND ALLIED DISORDERS (3) Modern theories of the causes of disorders of rhythm; methods of examination, diagnosis, and treatment. Prerequisite: Speech 490 or Speech Ed. 436. Lecture 3 hours.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

SPEECH ED. 430. PROBLEMS OF THE CHILD WITH A HEARING LOSS (3) *Professor E. T. McDonald*
SPEECH ED. 432. METHODS OF TEACHING SPEECH (LIP) READING (3) *Professor Margaret Raabe*
SPEECH ED. 433. AURICULAR TRAINING (2) *Professor Margaret Raabe*
SPEECH ED. 434. AUDIOMETRY (2) *Professor E. T. McDonald*
SPEECH ED. 435. CLINICAL PRACTICE WITH THE DEAF AND HARD-OF-HEARING (3)
SPEECH ED. 436. SPEECH DISABILITIES (3) *Professor E. T. McDonald*
SPEECH ED. 437. SPEECH CORRECTION (1-3) *Professor E. T. McDonald*
SPEECH ED. 439X. FUNDAMENTALS OF SPEECH EDUCATION (3)
SPEECH ED. 439aX. METHODS IN SPEECH EDUCATION (3) *Professor Margaret Raabe*
SPEECH ED. 440, 440X. SPEECH EDUCATION AND REEDUCATION IN THE ELEMENTARY SCHOOL (2-3) *Professor Margaret Raabe*
SPEECH ED. 441S. CURRENT PROBLEMS IN SPEECH AND HEARING (1-6)
SPEECH ED. 442. SPEECH PATHOLOGY (3)

ZOOLOGY

PROFESSOR EDWARD H. DUSHAM, M.S., Ph.D.
Head of the Department of Zoology and Entomology

ZOOL. 508. ADVANCED PARASITOLOGY (3) Advanced work on the structure, life cycle, and control of parasites. Prerequisites: Ent. 2, Zool. 432. Practicum 9 hours. *Professor C. C. Zeliff*

ZOOL. 509. TECHNIQUES IN WILD LIFE MANAGEMENT (3) The preparation of study mounts of game birds and mammals, methods of making a census, mapping management areas, method of collecting data, and determining food habits from examination of stomach contents. Prerequisite: Zool. 546. Lecture 1 hour, practicum 6 hours. *Professor P. F. English*

ZOOL. 512. SEMINAR (1) The review of current zoological literature. Required of graduate students majoring in zoology and entomology. Prerequisite: 12 credits in zoology or entomology. One conference per week. *Professor P. F. English*

ZOOL. 513. RESEARCH (1-15 per semester) The prosecution of an assigned problem under the guidance of an instructor. Prerequisite: Zool. 410, 432, 437, 440 or 546. *Professor E. H. Dusham and Staff*

ZOOL. 541. COMPARATIVE PHYSIOLOGY (3) The dynamics of vital processes as shown in members of the animal kingdom. Prerequisites: Zool. 25, 26; Agr. Biochem. 1; Agr. Biochem. 425 or Zool. 437. Lecture 2 hours, practicum 3 hours. *Professor H. W. Frings*

ZOOL. 546. THE THEORY OF GAME MANAGEMENT (4) Fundamental principles underlying the management of wild game birds and mammals; the co-ordination of such management with the various land uses; the planning of preserves and other land areas. Prerequisites: Zool. 408, 420. Lecture 3 hours, practicum 3 hours. *Professor P. F. English*

ZOOL. 547S. WILDLIFE MANAGEMENT (3) The basic principles concerned with the management of game birds and game mammals. Prerequisites: Zool. 25, 26, 420. Lecture 2 hours, practicum 3 hours. *Professor P. F. English*

ZOOL. 551. FISHERIES MANAGEMENT (3) The basic principles underlying the management of inland waters for fish production. Prerequisite: Zool. 450. Lecture 2 hours, practicum 3 hours.

ZOOL. 581. ADVANCED INVERTEBRATE ZOOLOGY (3) The morphology, physiology, taxonomy, and life histories of invertebrate animals. Prerequisite: Zool 580S. *Professor H. W. Frings*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ZOOL. 408. MAMMOLOGY (4) *Professor P. F. English*
ZOOL. 410. GENERAL LIMNOLOGY (3)

Zool. 414.	Herpetology (3)	
Zool. 415.	The Literature of Vertebrate Zoology (1)	
Zool. 416.	The Methods of Research in Zoology (2)	
Zool. 417.	Invertebrate Faunistics (4)	*Professor H. W. Frings*
Zool. 418S.	Field Ornithology (3)	*Professor Merrill Wood*
Zool. 419S.	General Animal Ecology (3)	*Professor N. D. Blackburn*
Zool. 420.	Game Birds (3)	*Professor P. F. English*
Zool. 432.	Human Parasitology (3)	*Professor C. C. Zeliff*
Zool. 436.	Protozoology (3)	*Professor C. C. Zeliff*
Zool. 437.	Histology (4)	*Professor G. B. Newman*
Zool. 440.	Embryology (4)	*Professor C. B. Newman*
Zool. 443.	Zoological Problems (3)	*Professor E. H. Dusham and Staff*
Zool. 444.	Zoological Problems (3)	*Professor E. H. Dusham and Staff*
Zool. 445S.	The Identification of Insects (3)	
Zool. 447.	Aquiculture (2)	
Zool. 448.	Ornithology (3)	*Professor M. Wood*
Zool. 450.	Ichthyology (4)	

The Pennsylvania State College Bulletin

GRADUATE SCHOOL ANNOUNCEMENT

1951

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1952

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STATE COLLEGE, PENNSYLVANIA

The Pennsylvania State College Bulletin

GRADUATE SCHOOL ANNOUNCEMENT

1951

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1952

PENN STATE COLLECTION

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COLLEGE

SPRING SEMESTER 1950-51

FEBRUARY 1951

1-3 Thursday to Saturday—Spring Semester Registration
5 Monday—Spring Semester Classes Begin

MARCH

20 Tuesday—Spring Recess Begins 5 p.m.
28 Wednesday—Spring Recess Ends 8 a.m.

MAY

7-8 Monday and Tuesday—First Phase Registration
29 Tuesday—Spring Semester Classes End 5 p.m.
30 Wednesday—Memorial Day Recess
31 Thursday—Spring Semester Examinations Begin 8 a.m.

JUNE

8 Friday—Spring Semester Ends 5 p.m.
10 Sunday—Baccalaureate Day, Class Day
11 Monday—Commencement Day

SUMMER PROGRAM 1951

JUNE 1951

12 Tuesday—Registration for Inter-Session in a.m.
12 Tuesday—Inter-Session Classes Begin 1:20 p.m.
29 Friday—Inter-Session Ends

JULY

2 Monday—Registration for Main Summer Session
3 Tuesday—Main Summer Session Classes Begin 8 a.m.
4 Wednesday—Independence Day Recess

AUGUST

10 Friday—Main Summer Session Ends 5:50 p.m.
11 Saturday—Main Summer Session Graduation Exercises
13 Monday—Registration for Post-Session in a.m.
13 Monday—Post-Session Classes Begin 1:20 p.m.
31 Friday—Post-Session Ends 5:50 p.m.

CALENDAR

FALL SEMESTER 1951-52

SEPTEMBER 1951

13-15 Thursday to Saturday—Fall Semester Registration
17 Monday—Fall Semester Classes Begin 8 a.m.

NOVEMBER
20 Tuesday—Thanksgiving Recess Begins 5 p.m.
26 Monday—Thanksgiving Recess Ends 8 a.m.

DECEMBER
3-4 Monday and Tuesday—First Phase Registration
19 Wednesday—Christmas Recess Begins 5 p.m.

JANUARY
3 Thursday—Christmas Recess Ends 8 a.m.
19 Saturday—Fall Semester Classes End 11:50 a.m.
21 Monday—Fall Semester Examinations Begin 8 a.m.
29 Tuesday—Fall Semester Ends 5 p.m.
29 Tuesday—Fall Semester Graduation Exercises

SPRING SEMESTER 1951-52

JANUARY 1952

JAN. 31, FEB. 1-2 Thursday to Saturday—Spring Semester Registration

FEBRUARY
4 Monday—Spring Semester Classes Begin 8 a.m.

APRIL
9 Wednesday—Spring Recess Begins 11:50 a.m.
16 Wednesday—Spring Recess Ends 1:10 p.m.

MAY
5-6 Monday and Tuesday—First Phase Registration
27 Tuesday—Spring Semester Classes End 5 p.m.
28 Wednesday—Spring Semester Examinations Begin 8 a.m.
30 Friday—Memorial Day Recess

JUNE
6 Friday—Spring Semester Ends 5 p.m.
8 Sunday—Baccalaureate Day, Class Day
9 Monday—Commencement Day

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RUTH C. SILVA, A.M., Ph.D. — *Assistant Professor of Political Science*
CYRIL B. SMITH, M.Sc., Ph.D. — *Assistant Professor of Plant Nutrition*
WARREN S. SMITH, M.A. — *Assistant Professor of Dramatics*
LEO H. SOMMER, M.S., Ph.D. — *Assistant Professor of Chemistry*
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JOSEPH ERIS STECKEL, Ph.D. — *Assistant Professor of Soil Technology*
FRANK BRISCOE STEPHENS, M.S., Ph.D. — *Assistant Professor of Meteorology*
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ALFRED FREDERICK WOELFEL, M.S. — *Assistant Professor of Electrical Engineering*
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KELLY YEATON, M.A. — *Assistant Professor of Dramatics*
C. COURSON ZELIFF, M.S., Ph.D. — *Assistant Professor of Zoology*
HARRY D. ZOOK, M.S., Ph.D. — *Assistant Professor of Chemistry*

INSTRUCTOR

JAMES W. SHIGLEY, M.S., Ph.D.
Instructor in Agricultural and Biological Chemistry

THE GRADUATE SCHOOL

THE GRADUATE SCHOOL was established in 1922. Graduate instruction had been given previously under the direction of a committee of the faculty or of the College Senate. The School has general control of all questions concerning graduate work. The faculty consists of such members of the instructional staff as have immediate supervision of graduate courses.

In the Graduate School routine requirements are reduced to a minimum. So far as they exist, they are for the purpose of furnishing the dicipline and methods necessary for independent study and investigation. It is the object of the School to surround the student with conditions that will enable him to devote himself to some chosen field. Advanced degrees are conferred as a mark of attainment of certain standards of scholarship.

The President of the College, on recommendation of the Dean of the Graduate School, will welcome Doctors of Philosophy of The Pennsylvania State College, as well as those of other accredited colleges and universities, as guests of the College, with the privilege of attending seminars and research courses and of carrying on research in laboratories and libraries. There will be no charge except for laboratory expenses. Arrangements should be made in advance with the Dean of the Graduate School.

ADMISSION—To be admitted to the Graduate School, an applicant must have received a baccalaureate degree from an accredited institution, earned under residence and credit conditions substantially equivalent to those required by this College. Graduates of The Pennsylvania State College must have had a minimum grade point average of 1.5 in their junior and senior years. Graduates of other institutions with different systems of grading must have had equivalent standing.

A student applying for admission, after having attended another graduate school where a substantial amount of credit has been earned, or a student whose career subsequent to graduation has been characterized by unusual attainments in fields having a bearing on his graduate qualifications, will be rated by a combination of the records submitted.

Admission is granted by the Dean of Admissions. If the applicant has attended more than one institution, an official transcript of the work covered at *each* institution is required. This applies to the complete academic record, both undergraduate and graduate. The applicant should have official credentials submitted directly from institutions to the Dean of Admissions as early as possible. A graduate of The Pennsylvania State College may present his final grade report or an official transcript of his complete record at the time he applies for admission to the Graduate School.

General inquiries regarding graduate work should be addressed to the Dean of the Graduate School. A student should not hesitate to write directly to the head of a department if he has specific questions regarding the work of that department.

CLASSIFICATION—At the time of admission all candidates must enroll as either *Regular* or *General* graduate students. The difference is as follows:

Regular Graduate Students (degree candidates)—This group includes all those who desire to become candidates for advanced degrees. Their complete status is determined and conditions of candidacy are arranged. A program is developed under the guidance of an adviser. A matriculation fee of $5 should accompany the application for admission.

General Graduate Students (nondegree candidates)—Applicants who meet all requirements for admission but who have not decided to become candidates for an advanced degree at this institution may arrange for a program of work as general graduate students. This classification is open to those who wish to transfer credit to another institution or who wish to fulfill requirements other than those of advanced degrees. An admission fee of $1 should accompany the application for admission.

If a student enrolled as a general graduate student desires to become a candidate for an advanced degree, he may do so by making application to the Dean of the Graduate School. A matriculation fee of $5 will be charged.

Not more than six credits earned as a general graduate student may be used toward the requirements for a degree.

REGISTRATION—All students must register at the beginning of each semester or summer session. Registration days are shown in the College Calendar on pages 4 and 5. Graduate students are allowed one week for registration following the regular semester registration days before the late fee of $10 is imposed.

The student must prepare each term a program satisfactory to the major department or group committee. When this schedule is approved by the Dean of the Graduate School, the student completes the registration forms and pays his fees.

Under certain conditions credit may be earned by work done off the campus. Students contemplating such work should request details from the Dean of the Graduate School.

CHANGES IN THE PROGRAM—When a change in program is essential, it may be made only with the approval of the Dean of the Graduate School. If the student should make a change in his major or in the degree toward which he is working, he would also be required to make such change through the office of the Dean of Admissions, and his status would be determined at that time. A fee of $2 is charged for each change of schedule.

CREDITS AND GRADES—All grades for graduate students are reported each term to the Registrar. Courses numbered in the 500 series are marked on the basis of P (pass), H (honors), or F (fail). For work taken in the 400 series a passing grade of 2 is required.

GRADUATE SCHOOL FEES

Matriculation fee (regular students)	$ 5.00
Admission fee (general students)	1.00
Incidental fee, each semester	50.00
General fixed fee, each semester	45.00
Health service fee (applicable to scholars, fellows, and graduate assistants)	7.50
Part-time fee, per credit (for less than 12 credits)	9.00
Late registration fee	10.00
Late payment or deferment fee	5.00
Change of schedule fee	2.00
Graduation fee	10.00
Transcript of record (extra copy)	1.00
Off-campus registration fee, each year	2.50

Summer session students who register for graduate courses pay the regular fees for the summer sessions.

In addition to the above fees, all full-time students who are not residents of Pennsylvania are charged a tuition fee of $110 per semester; part-time students are charged an additional $9 per credit. There is no exemption from these fees, except for scholars, fellows, and graduate assistants.

Whenever it shall appear from any of the data presented as part of the application for admission that the applicant is not a resident of Pennsylvania, the Dean of Admissions, when admission is granted to that applicant, assumes that the one admitted is a non-Pennsylvanian. A student so admitted is held liable for the out-of-State tuition fee.

If the one who is admitted believes that his circumstances do not justify his classification as a non-Pennsylvanian, he may petition the Dean of Admissions for reclassification.

Whenever such a petition for reclassification is made, the petitioner is required to present proof of bona fide continuous residence of the one admitted (or his parents, if he is a minor) within the Commonwealth for a period of not less than 12 months immediately preceding his admission; and, in addition, such other evidence as may appear pertinent to a complete review of the classification.

CANDIDACY FOR ACADEMIC AND PROFESSIONAL DEGREES

In order to be admitted to candidacy for an advanced degree, the applicant must meet in full (1) the requirements for admission to the Graduate School, (2) certain undergraduate preparation necessary for the particular major chosen, and (3) a planned program approved by the major department.

ACADEMIC DEGREES

PREREQUISITE FOR CANDIDACY—Ample undergraduate preparation in the field in which the candidate intends to carry on graduate work is required. The number of undergraduate credits required varies in different departments. Full information as to what is considered adequate in the various fields is on file in the office of the Dean of Admissions. An applicant who is deficient in preparation may under certain conditions be admitted to the Graduate School but not to candidacy for a degree until he satisfies the requirements. This does not apply to a deficiency in the 1.5 scholastic average. If there is a deficiency in this regard, the applicant will be refused admission to the Graduate School. An applicant who has been admitted to the Graduate School but who lacks the required undergraduate credits for the major chosen will be allowed to follow a program satisfactory to the major department. It is likely that his program will require more than the minimum residence.

DEGREES OF MASTER OF ARTS AND MASTER OF SCIENCE

Two degrees are conferred, Master of Arts for those proceeding in the liberal arts, and Master of Science for those proceeding in science or technology.

REQUIREMENTS—A course for the master's degree requires a minimum of 30 credits and consists of one major and not more than two minor subjects. The program requires the equivalent of one academic year (two semesters), or at least 30 weeks, and may be met by full-time residence, part-time work, attendance in the summer sessions, or by any combination of these. Students not adequately prepared, or assistants and other part-time students, will require more than this time to attain the master's degree. Three credits earned in residence at another approved institution or in the extension classes of The Pennsylvania State College under certain conditions may be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within a period of six years.

At least 12 credit hours and a thesis equivalent of 6 credits must be devoted to the major subject. Twelve credits may be offered in courses open to upper-class and graduate students (courses with 400 numbers). A student's program must be approved by the head of the major department and the Dean.

Choice of the major and minor subjects must be dependent upon adequate preparation. Except by permission of the Dean, one minor subject must be chosen in a field of study different from that of the major. The mere completion of a stated amount of work does not entitle a candidate to recommendation for a degree. He must pass examinations upon such subjects and at such times as shall be designated by the departments concerned and must present an acceptable thesis.

THESIS—Under the direction of the department in which the candidate's major subject is taken, he must prepare a thesis upon a suitable topic related to that subject. Under certain conditions a student may be permitted to complete the

thesis *in absentia*. To obtain such permission the student must make satisfactory arrangements both with the major department and with the office of the Dean.

For instructions concerning the form and the filing of typewritten copies of the thesis, see pages 31 and 32.

DEGREE OF DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy (Ph.D.) is conferred in recognition of high attainments and productive scholarship in some special field of learning as evidenced (1) by the satisfactory completion of a prescribed period of study and investigation; (2) by the preparation of a dissertation involving independent research; and (3) by successfully passing examinations covering both the special subject and the general field of learning of which this subject forms a part.

RESIDENCE REQUIREMENTS—A minimum of three academic years of resident graduate study and research are required for the attainment of a doctor's degree. Students not devoting full time to graduate study will be required to extend their work over a longer period. Credit for part-time work will be based on the actual time spent in the pursuit of graduate work. Work of equal grade done in residence at other institutions and residence for a master's degree may be accepted by the Dean of Admissions and the faculty as partial fulfillment of the requirements, but at least one academic year must be spent at this institution. While the minimum residence requirements must be met, it is understood that the time requirement is secondary to other considerations.

One-third of the residence requirements for a Ph.D. degree may be met by research work away from the College in branch laboratories of the College, or research laboratories not connected with other degree-granting institutions, or in other centers where there are opportunities for research under the following conditions:

(a) The candidate shall have had at least one year's work in residence.
(b) The plan must have the approval of the group committee.
(c) Reports on the work shall be made as directed by the group committee.

A candidate for a doctor's degree, doing graduate work off the campus, may obtain in this manner a maximum of six credits in an academic year, September to June, or nine credits in a calendar year. This does not apply to resident students temporarily assigned to other locations when, in the judgment of the Dean of the Graduate School, and the head of the department concerned, such assignment seems desirable.

Work done off the campus, which is to be credited toward a doctor's degree, must be scheduled *in advance* with the Dean of the Graduate School and the Dean of Admissions.

WORK DONE ELSEWHERE—Acceptance of residence in another institution as partial fulfillment of the requirements toward an advanced degree, shall be by

authority of the Dean of Admissions. In determining to what extent the work done elsewhere may meet the course requirements at this institution each case will be decided on its merits by the group committee, or by the Dean and heads of the departments concerned.

PROGRAM OF WORK—A program shall consist of a major and one or two minor subjects. Two-thirds of the total time is to be devoted to the major subject. A division of the remaining one-third of the total time on the basis of two to one between the first and second minors is satisfactory. The heads of the major and minor departments or their representatives, together with the Dean, constitute a special group committee which shall have general charge of the arrangement of the program.

For the first year of graduate study leading to the doctor's degree, 30 credit hours is considered a full-time program. The first year's work may be substantially the same as that provided for the master's degree, and may lead to that degree, although that is not necessary.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department that he is prepared to proceed and is recommended by his group committee.

There is no specified number of courses or credits for the attainment of the doctor's degree. A program shall consist of such a combination of courses and research as is approved by the group committee for each individual student. Students devoting only a portion of their time will be credited on their residence requirements in proportion to the time actually spent in graduate study and research.

DISSERTATION—The ability to do independent research must be proved by the preparation of a dissertation on some topic in connection with the major subject. It should represent a contribution on some worth-while problem presented in a scholarly manner. The contents and conclusions of the dissertation must be defended at the time of the final examinations.

The general subject of the dissertation must be determined at the time of admission to candidacy for the degree, and the completed dissertation, typewritten in triplicate copy, must be filed in the office of the College Librarian not later than one week prior to the commencement at which the candidate expects to take the degree.

For regulations concerning the form and the filing of the dissertation, see pages 31 and 32.

EXAMINATIONS—Preliminary or qualifying examinations are required in the major and minor subjects to determine whether the candidate has made satisfactory progress and is entitled to the privilege of completing the requirements for the degree. These examinations are scheduled at a time when one-third of the residence requirements remain to be satisfied. They are given by a committee representative of the departments concerned and such other members as the Dean may appoint. The candidate must have satisfied the language requirements before taking the preliminary examinations.

Candidates for the degree of Doctor of Philosophy are required to have a reading knowledge of French and German unless an exception is arranged. Upon the recommendation of the major department and the approval of the Dean, the substitution of another foreign language may be authorized for either French or German. In the case of foreign students, German and English will commonly serve as the foreign languages, unless one of these be the mother tongue. Certificates of proficiency must be obtained from the respective language departments of this College, or from the Dean of Admissions provided language requirements have been met at another institution. Candidates not presenting certification of reading ability at the time of admission should make immediate arrangements to acquire that ability either through class work or by tutoring. The language requirements must be satisfied prior to the scheduling of the preliminary examinations. The language examinations will be administered three times each year, ordinarily between 7 and 9 p.m. on the first Monday in November, the first Monday in March, and the Monday of the fifth week of the regular Summer Session. Registration for the examinations must be completed in the respective departments no later than one month prior to the date of the examinations.

The final examination for the doctor's degree is conducted by a committee representative of the departments concerned and such other members as may be appointed by the Dean, who shall also designate the time and place. The examination is oral, open to the public, and covers the whole field of study of the candidate without regard to courses that may have been taken either here or elsewhere.

PROFESSIONAL DEGREES IN EDUCATION

PREREQUISITES FOR CANDIDACY—In order to provide graduate work which would utilize more fully the professional training and background of those holding bachelors' degrees from teachers colleges and schools of education, these professional degrees in education were established.

All candidates are required to have had at least 27 undergraduate credits in the field of education, including practice teaching. If a candidate elects to specialize in a subject-matter field, then certain additional prerequisites are required for that subject. The amount of preparation varies in the different fields. Full information concerning the preparation required by the various departments is on file in the office of the Dean of Admissions. If there are deficiencies at the time of admission they must be removed before candidacy for a degree is completed. While making up deficiencies in prerequisite credits a student must follow a program satisfactory to the major department. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School.

Candidates for the advanced degrees in education are required to take a qualifying comprehensive examination before completing the second half of their course requirements, which serves as a guide in outlining a program of study that will meet the individual needs of the candidate.

DEGREE OF MASTER OF EDUCATION

The degree of Master of Education represents general scholarship, acquaintance with the chief phases of educational literature, teaching skill, qualities of leadership in educational work, and ability to solve concrete problems in at least one special field of education.

The following regulations govern candidacy for the degree of Master of Education:

RESIDENCE AND COURSE REQUIREMENTS—A minimum of 30 credits, 6 of which may be granted for an approved thesis. The program requires the equivalent of one academic year (two semesters), or at least 30 weeks, and may be met by full-time residence, part-time work, attendance in the summer sessions, or any combination of these. Three credits earned in residence at another approved institution or in extension classes of The Pennsylvania State College, under certain conditions may be offered as partial fulfillment of the requirements. All requirements must be met within a period of six years.

A minimum of 24 credits is to be earned in graduate course work. It is expected that the larger part of this work shall be in courses open only to graduate students, but the needs of the student shall be considered in arranging the best combination of courses (400 and 500 series) for the preparation of the candidate in his special field.

If a student looks forward to a career as a teacher, he may specialize in a specific field (as English, mathematics, Latin, etc.), and that shall be regarded as the major field, and a majority of the work is to be taken there. If a broader field is sought, a group major may be chosen (as social studies, general science, etc.). In this case a larger percentage of the 24 credits is to be devoted to the subjects forming the group major. The remainder of the program is devoted to a minor in the field of education, consisting of approximately one-third of the required credits, depending on the previous preparation, experience, and objectives of the candidate. In case the candidate's undergraduate preparation has not included courses in the scientific study of education and advanced educational psychology, a course in each of these fields must be included.

Those desiring to prepare as supervisors and administrators may choose a major and a minor within the curricula of Education. The following fields are recommended: secondary school principal, elementary school principal, superintendent of schools, guidance counselor, vocational director, or supervisor.

The candidate may choose one field of work for a major and another field for a minor. These majors prepare for State certificates in those fields where special certificates are given. It is possible to arrange programs of study concentrated in other fields.

ADVISORY COMMITTEE—When the major is in a specific field the heads of the major and minor departments or fields (or their representatives) together with the supervisor of the problem course (thesis) constitute a special advisory committee which shall approve the study program. In practice the general guidance of a

student is centered in an adviser from the major department, who is familiar with the field in which the student is specializing.

When the student chooses a group major his study program will be approved by a standing committee (or its representatives), which committee will foster the student's interests and stand in the same relation to him as does a department in the case of a student with a specific major. Such standing committees have been appointed in the broad fields of biological science, physical science, and social studies.

THESIS—Under the direction of a supervisor representing either a major department or a standing committee supervising group majors, an amount of time equivalent to six credits may be devoted to problem work and the preparation of a thesis. Under certain conditions this may be carried out in part *in absentia*, particularly when requirements are met by summer session attendance.

Course work may, under certain conditions, wholly or in part, take the place of the problem and thesis work. Application for the opportunity to substitute six credits of course work for the thesis must be filed with the candidate's advisory committee or adviser before the candidate completes more than 12 of the 30 credits required for the degree. The application must include the statement of the major and the titles and numbers of the courses which the candidate wishes to submit in substitution for the thesis.

For instructions concerning the form and the filing of the thesis, see pages 31 and 32.

EXAMINATIONS—Candidates for the Master of Education degree must pass a final comprehensive examination. The examination will be designed to determine the ability of the candidate to apply the general, as well as the special, knowledge of his chosen field in practical situations.

DEGREE OF DOCTOR OF EDUCATION

The degree of Doctor of Education is conferred in recognition of scholarship and teaching or administrative skill as evidenced by (1) the satisfactory completion of a prescribed period of study, (2) the application of scientific principles in classroom teaching, in the supervision of instruction, or in administrative work, (3) by the preparation of a dissertation demonstrating ability to attack an educational problem with originality and independent thought, (4) by successfully passing examinations showing a satisfactory grasp of the field of specialization and its relation to allied subjects, and (5) by recognized leadership in the profession of education.

RESIDENCE—An equivalent of three years of graduate study is required as a minimum for the doctor's degree. However, it is not required that the three years be continuous. Graduate study may be carried on through a longer period and paralleled by teaching or administrative work.

Work of equal grade done in residence at other institutions, and residence for a master's degree, may be accepted as partial fulfillment of the requirements, but

in addition at least one academic year or its equivalent must be spent in residence at this institution. For students pursuing work beyond the master's degree a combination of sessions amounting to at least 30 weeks is regarded as the equivalent of an academic year. While it may be possible to fulfill the minimum residence requirement as just stated, it is expected that candidates for the doctorate will be taking a much greater amount of work in the institution. Those completing requirements in summer sessions will continue during the regular school year in some educational situation, under the guidance of members of the faculty, study and research programs set up in summer courses.

One-third of the requirements (equivalent to a 30-credit year) for the degree of Doctor of Education may be met by research work pursued away from the campus in the school systems of the State, or in other approved centers not connected with degree-granting institutions, provided (1) the plan be approved by the student's advisory committee, (2) reports on the projects be made as directed by the advisory committee, (3) not more than six credits be earned in an academic year, September to June, or nine credits in a calendar year.

Work done off the campus, which is to be credited toward a doctor's degree, must be scheduled *in advance* with the Dean of the Graduate School and the Dean of Admissions.

PROGRAM OF STUDY—The program of study shall be so arranged as to lead toward high professional mastery within some area of educational service. A majority of the courses offered in fulfillment of the requirement will be in the major field of study. The remainder shall be in one or two minors bearing some functional relation to the major and to the work the candidate is planning to do. These minors may be in academic subjects or in some phase of education or psychology other than the major. In the case of persons intending to continue in classroom teaching rather than in administrative or supervisory positions, a larger proportion of the work may be assigned to the academic fields in which the candidate is teaching, to whatever extent the advisory committee may believe the background and the objectives of the particular candidate warrant. But every candidate for the degree of Doctor of Education must show through a comprehensive examination that he is familiar with current theories of education; that he understands and can apply the techniques and the findings of educational research so far as they bear upon the teaching of his subject; that he is prepared to read understandingly, and to contribute to, the technical professional literature in his field; and that he can criticize his own procedures in the light of historical trends and practices in this and other countries.

Command of the tools for a thorough study of the problems of education is necessary and must include familiarity with statistical methods. For certain students the requirements may include a reading knowledge of one or more foreign languages.

There is no specified number of courses or credits for the attainment of the doctor's degree. The general requirements are based not upon courses or credits but upon a definite residence, a satisfactory dissertation, the passing of a comprehensive examination, and possession of the qualities of professional leadership. A

program shall consist of such a combination of courses and individual study and research as is approved by the advisory committee for each student.

ADVISORY COMMITTEE—The heads of the major and minor departments or fields (or their representatives), the supervisor of the dissertation, together with the Dean of the Graduate School, constitute a special advisory committee which shall have charge of the arrangement of the study program.

DISSERTATION—Evidence of a high degree of scholarship and ability to select, organize, and apply knowledge must be presented by the candidate in the form of a written dissertation. The candidate must demonstrate capacity for independent thought and ability and originality in the application of educational principles or in the development of new generalizations under scientific controls. The topic and outline of the proposed thesis must have the approval of the advisory committee.

For instructions concerning the form and filing of the dissertation, see page 31.

EXAMINATION AND ADMISSION TO CANDIDACY—In order to be admitted to full candidacy for the degree each candidate shall pass preliminary qualifying examinations administered by the committee on qualifying examinations. The qualifying examinations may not be taken until after one semester of work has been completed at this institution. They are scheduled at a time when one-third of the residence requirements remain to be satisfied. Examinations will be held at times arranged with the head of the major department. The qualifying examinations will be designed to test (1) the candidate's general scholastic preparation and professional background; and (2) his ability to integrate and apply his knowledge in his fields of specialization to practical situations so as to reflect an intelligent mastery of the subjects.

Three of the important factors taken into consideration in passing judgment upon the application of a candidate for admission to candidacy are:

(a) Previous scholastic record at this institution and other institutions attended;

(b) Achievement in qualifying examinations;

(c) Estimates of his personal and professional qualifications by members of the advisory group.

The advisory committee will make recommendations to the Dean of the Graduate School, and the candidates will be advised of the decision with regard to their applications for candidacy within 10 days following the date of each qualifying examination.

A candidate who has fulfilled all other requirements for the degree will, on recommendation of his advisory committee, be permitted to take the final oral examination for the degree. The committee in charge of this examination will consist of the student's advisory committee and others appointed by the Dean of the Graduate School. The examination will be based upon the dissertation and related problems. Arrangements for taking the final examination must be made with the Dean of the Graduate School, through the advisory committee and the major department, not later than two weeks prior to a commencement date.

PROFESSIONAL DEGREE IN FORESTRY

The degree of Master of Forestry represents scholastic ability, acquaintance with forestry literature, and technical knowledge of one or more of the several specialized fields in forestry or wood utilization. It is offered to provide an opportunity for additional study in a student's particular field of interest, rather than for research work on a special problem, though such work is not precluded under the requirements for the degree.

PREREQUISITES FOR CANDIDACY—A candidate is required to hold a baccalaureate degree, or its equivalent, from a recognized professional school of forestry. Full information concerning the preparation required in either general forestry or wood utilization is on file in the office of the Dean of Admissions. If there are deficiencies at the time of admission they must be removed before candidacy for a degree is completed. While making up deficiencies in prerequisite credits, the student must follow a program approved by his advisory committee. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School.

RESIDENCE AND COURSE REQUIREMENTS—A minimum of 30 credits is required for the degree of Master of Forestry. These credits are to be taken in the best arrangement of courses bearing 400 and 500 numbers suited to the needs of the individual student. Although not required, a maximum of 6 credits may be assigned to a thesis upon approval and recommendation of the head of the Forestry Department. All requirements must be met within a six-year period.

A maximum of three credits may be earned in extension classes of The Pennsylvania State College, or in resident classes of other approved institutions, provided these credits have the approval of the Dean of Admissions and fit into the program of the student.

A student should choose one field of work for his major interest with one or two related minor fields. The proportion of credits to be taken in the major and minor fields of study will be determined in consultation with an advisory committee. Ordinarily this committee consists of the head of the Forestry Department and the professors in charge of the major and minor fields.

TECHNICAL DEGREES

ADMISSION—A graduate of the School of Chemistry and Physics, of the School of Engineering, or of the School of Mineral Industries of The Pennsylvania State College may be admitted to candidacy for a technical degree, provided he submits evidence of having been engaged for a period of not less than three years in acceptable professional work in the field of engineering in which the application for the degree is made.

A technical degree may also be granted to an engineer of approved practical experience, who is a graduate in engineering of another institution of equal standing, on completion of at least three years of full-time teaching or research work in

engineering in a professorial rank in this institution and upon presentation of an acceptable thesis and the fulfillment of all other requirements for technical degrees. An applicant who is eligible for a technical degree is admitted to the Graduate School by the Dean of Admissions.

REGISTRATION—A candidate for a technical degree must file with the Dean of Admissions an application filled out in duplicate on the prescribed forms, approved by the head of the department in which the undergraduate work was completed. The application should be accompanied by the matriculation fee of $5.

Registration for these degrees is the same as for resident students. A candidate must be registered during two regular semesters.

DEGREES AND REQUIREMENTS—The technical degrees are as follows: Aeronautical Engineer, Architectural Engineer, Chemical Engineer, Civil Engineer, Electrical Engineer, Fuels Engineer, Industrial Engineer, Ceramic Engineer, Mechanical Engineer, Engineer of Mines, Metallurgical Engineer, Petroleum Engineer, and Sanitary Engineer.

Not less than three years shall have elapsed from the time of receiving the first degree before a graduate of this institution shall be permitted to file his application for a technical degree. The application for a technical degree shall include evidence of a satisfactory professional record, which must be approved by the executive committee of the undergraduate School concerned.

In order to be recommended for a technical degree the candidate must prepare a thesis on a subject related to his profession. He must register in the manner specified in the foregoing paragraph and pay the registration and diploma fees. He may be required to appear in person to defend his thesis.

THESIS—Immediately following registration the candidate must submit for approval an outline of his proposed thesis, and at least six weeks prior to the day on which the degree is to be conferred, the complete thesis must be in the office of the head of the department concerned.

For regulations concerning the form and filing of the thesis, see below.

FEES—Each candidate for a technical degree must pay a matriculation fee of $5 and a diploma fee of $10 when recommended to the College Senate for the degree. Fees are payable by check drawn to the order of The Pennsylvania State College. The matriculation fee is sent to the Dean of Admissions, the diploma fee to the Bursar.

REGULATIONS FOR THESES AND DISSERTATIONS

It is required that three typewritten copies of theses and dissertations be presented. They are due in the office of the College Librarian not later than one week prior to the day on which the degree is to be conferred.

Before arranging for the typing, the candidate must obtain information from the College Librarian concerning the format, paper, illustrations, etc.

A thesis for a master's or a technical degree thus submitted and approved becomes wholly the property of the College, and may not be published, in whole or in part, without authorization of the Dean of the Graduate School and the head of the department concerned.

A candidate for a doctor's degree must satisfy also one of the following requirements as to the dissertation not later than one week prior to the day on which the degree is to be conferred:

1. Publication of the dissertation in a manner satisfactory to the College Librarian and deposit of 100 copies in the College Library; or

2. Presentation of a typewritten abstract, satisfactory to the major department and the College Librarian and the sum of $35. The Librarian will then arrange for the printing of the abstract. Fifty copies of the printed abstract will be furnished to the candidate without additional cost.

GRADUATE ASSISTANTSHIPS AND OTHER AIDS

A number of appointments as assistants in teaching or research work, or awards as fellows, or scholars, are available with varying stipends and exemption from the incidental fee, the general fixed fee, and the out-of-State tuition fee. A health service fee of $7.50 is assessed, from which there is no exemption. The application for appointment should be made to the head of the department in question. The graduate program that can be carried is proportioned to the service rendered.

GRADUATE ASSISTANTSHIPS—Appointments for 9 months, September 15 to June 15 (stipend $1008), or for the fiscal year (stipend $1344); service one-half time; program two-thirds.

SPECIAL GRADUATE ASSISTANTSHIPS—Appointments for 9 months (stipend $1512), or for the fiscal year (stipend $2016); service three-fourths time; program one-half.

GRADUATE STIPEND SCHOLARSHIPS—Appointments for 9 months (stipend $504), or for fiscal year (stipend $672); service one-fourth time; program four-fifths.

DU PONT FELLOWSHIP IN CHEMISTRY—Candidate recommended by the Department of Chemistry and approved by a member of the fellowship committee of the du Pont Company (stipend $1200 minimum).

RESEARCH AND INDUSTRIAL FELLOWSHIPS—Numerous fellowships offered by various outside agencies for the investigation of special problems (stipends vary). Information is obtainable from the departments.

THE JOHN W. WHITE FELLOWSHIPS—Awarded to two graduates of The Pennsylvania State College each year on the basis of scholarship, need, character, and attitude.

THE ELLIOTT FELLOW IN ENGINEERING RESEARCH—An annuity provided by W. S. Elliott, of Pittsburgh, for a student in engineering who must be a graduate of this College.

GRADUATE SCHOLARSHIPS—A limited number of scholarships without stipends, but with exemption from the incidental, general fixed, and out-of-State tuition fees, are assigned to the various departments. The holder is required to render some service, but a master's degree may be earned on the basis of one academic year. Application may be made to the Dean of the Graduate School, or to the head of the department in question.

GRADUATE COURSES

The course descriptions which follow are arranged alphabetically according to departments. If any specific course cannot be located readily, refer to the table of contents, pages 2 and 3.

The courses of instruction in all departments of the College are numbered in accordance with a unified plan, as follows:

UNDERGRADUATE COURSES, numbered 1 to 399, are general courses accepted in fulfillment of the requirements for the bachelor's degree.

UPPER-CLASS AND GRADUATE COURSES, numbered 400 to 499, are advanced courses open for credit to undergraduate students of at least junior standing and to graduate students under the restriction that no more than 12 credits in these courses may be offered in fulfillment of the requirements for the degrees of M.A. and M.S.

GRADUATE COURSES, numbered 500 to 599, are courses for graduate students only. The name of the person in charge of the instruction for the course usually follows the description. Senior students of The Pennsylvania State College not required to carry a full program for graduation, with permission of the Dean of the School in which they are enrolled and of the Dean of the Graduate School, may attend such courses and be allowed credit under special conditions. *Many departments reserve the right to say which of certain graduate courses may be given in any semester; the heads of departments should be consulted.*

The figures in parentheses following the title of the course indicate the number of credits granted for that course. A considerable number of graduate courses are offered in the summer sessions. When these courses are also given during the regular academic year they are not listed separately as summer session courses in this announcement. For a complete list of courses given during a specific summer or summer session, consult the *Complete Announcement of the Summer Sessions* for that particular year. In the section which follows, courses given during the summer session (*but not during the regular academic year*) have numbers followed by the letter "S." Courses given in extension only have numbers followed by the letter "X."

AERONAUTICAL ENGINEERING

Professor David J. Peery, M.S.E., C.E., Ph.D.
Head of the Department

Aero.E. 500. Thesis (1-9)

Aero.E. 501. Airplane Stability and Control (3) General analysis of longitudinal and lateral stability of airplanes; characteristics of flight control devices. Prerequisite: Aero.E. 403.

Aero.E. 503. Airplane Performance (3) Methods of performance prediction and performance flight testing for high-speed aircraft and missiles. Prerequisite: Aero.E. 403.

Aero.E. 504. Rotary Wing Aircraft (3) Types of rotary wing aircraft; helicopter performance, stability, and control; structural and vibration problems. Prerequisites: Aero.E. 403, 409.

Aero.E. 505. Aircraft Vibration and Flutter (3) Vibrating systems with several degrees of freedom; analysis of flutter speed of an airplane wing considering bending, torsion, and aileron motions; other types of aircraft flutter. Prerequisites: Aero.E. 1, M.E. Des. 8.

Aero.E. 506. Advanced Aircraft Structures (3) Deflections of beams and trusses; statically indeterminate structures; shear-flow analysis and shearing deformations of multi-cell semi-monocoque structures; effects of discontinuities in wing and fuselage structures. Prerequisite: Aero.E. 409.

Aero.E. 507. Aircraft Gas Turbines and Jet Propulsion Engines (3) Types of jet propulsion installations, thermodynamic cycles, analysis of compressors, combustion chambers, and turbines. Prerequisite: Aero.E. 410.

Aero.E. 510. Aerodynamics of Compressible Fluids (3) One-dimensional motion, shock waves, flow in nozzles, two-dimensional flow, airfoil theory, Prandtl-Meyer flow, method of characteristics. Prerequisites: Aero.E. 412, M.E. 2.

Aero.E. 511. Aerodynamics of a Perfect Fluid (3) Euler's dynamic equations, complex potential, conformal transformation, thin airfoils, Biot-Savart law; Prandtl three-dimensional airfoil theory. Prerequisite: Aero.E. 412.

Aero.E. 512. Aerodynamics of a Viscous Fluid (3) Navier-Stokes equations, incompressible and compressible boundary layer theory, jet and wake problems, hydrodynamic stability, turbulence. Prerequisite: Aero.E. 412.

Aero.E. 513. Research in Aeronautical Engineering (1-15 per semester) Investigation of a theoretical or experimental project in aeronautical engineering.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Aero.E. 401a,b,c. Aeronautical Engineering Projects (2-12)

AERO.E. 402. AIRPLANE ENGINE DESIGN (4)
AERO.E. 403. APPLIED AERODYNAMICS (3)
AERO.E. 404. AIRPLANE DESIGN (4)
AERO.E. 407. ROTARY WING AIRCRAFT (3)
AERO.E. 408. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3)
AERO.E. 409. AIRPLANE DETAIL DESIGN (3)
AERO.E. 410. AIRCRAFT PROPULSION (3)
AERO.E. 411. AIRCRAFT STRUCTURES (3)
AERO.E. 412. THEORETICAL AERODYNAMICS (3)

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

PROFESSOR R. ADAMS DUTCHER, M.S., A.M., D.Sc.
Head of the Department

AGR. BIOCHEM. 501. ENZYMES (2) Investigations and theories concerning nature of enzymes, enzyme action, influence of chemical environment on enzyme action, and biological applications. Prerequisite: Agr. Biochem. 437. *Professor Jensen*

AGR. BIOCHEM. 502. PHYSICAL CHEMISTRY OF THE CELL (3) Lectures and assigned reading reviewing current literature relative to physical chemistry of living tissues and life processes. Prerequisite: Agr. Biochem. 426. *Professor Lisse*

AGR. BIOCHEM. 503. RESEARCH (3-15) The prosecution of an assigned problem under the guidance of an instructor. Prerequisite: Agr. Biochem. 417. For certain problems additional courses may be considered as prerequisite.
Professor Dutcher and Staff

AGR. BIOCHEM. 504. THESIS RESEARCH (3-15 per semester)
Professor Dutcher and Staff

AGR. BIOCHEM. 505. VITAMINS AND DIETARY DEFICIENCY DISEASES (2) Lectures, conferences, and assigned reading. Prerequisite: Agr. Biochem. 437.
Professor Dutcher

AGR. BIOCHEM. 506. VITAMIN ASSAY METHODS (2) Lectures, conferences, and demonstrations dealing with approved methods of vitamin assay and including demonstrations of typical vitamin deficiency syndromes in the rat. Prerequisite: Agr. Biochem. 505. *Professor Guerrant*

AGR. BIOCHEM. 507a. SEMINAR IN PHYSIOLOGICAL CHEMISTRY AND NUTRITION (1)
Professors Dutcher, Guerrant, Anderson, Boucher, Miller, and Pritham

AGR. BIOCHEM. 507b. SEMINAR IN FOODS AND ANALYTICAL CHEMISTRY (1)
Professors Triebold and Althouse

AGR. BIOCHEM. 507c. SEMINAR IN PLANT, SOIL, AND INSECTICIDE CHEMISTRY (1)
Professors Frear and Jensen

AGR. BIOCHEM. 508. RESEARCHES IN PLANT CHEMISTRY (3) Lectures and assigned readings reviewing the more important chemical investigations in plant chemistry. Prerequisite: Agr. Biochem. 437. *Professor Jensen*

AGR. BIOCHEM. 509. BIOCHEMICAL METHODS (3) An advanced laboratory course involving special methods used in biochemical research on plant and animal materials. Prerequisite: Agr. Biochem. 437. *Professor Anderson*

AGR. BIOCHEM. 510. PROTEINS (2) The chemical constitution of proteins, their physical and biochemical properties, their function in nutrition, and their fate in metabolism. Prerequisite: Agr. Biochem. 437. *Professor Anderson*

AGR. BIOCHEM. 511. CARBOHYDRATES (2) Study of research work dealing with the carbohydrates and their metabolism in the plant and animal organisms. Prerequisite: Agr. Biochem. 437. *Professor Jensen*

AGR. BIOCHEM. 512. LIPIDS (2) Investigations on the biochemistry of fats and related substances. Prerequisite: Agr. Biochem. 437. *Professor Triebold*

AGR. BIOCHEM. 513. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (4) Laboratory course, quantitative in nature, valuable as preparation for Agr. Biochem. 502. Hydrogen-ion concentration, electrometric titration, buffers, oxidation-reduction potential, and membrane potential. Prerequisite: Agr. Biochem. 425 or Chem. 41, 43. *Professor Lisse*

AGR. BIOCHEM. 514. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (3) Continuation of Agr. Biochem. 513. *Professor Lisse*

AGR. BIOCHEM. 515. BIOMETRY (2) The application of statistical methods to research problems in biochemistry and biology. Prerequisites: Agr. Biochem. 437, Math. 30. *Professor Miller*

AGR. BIOCHEM. 516. CHEMISTRY OF INSECTICIDES AND FUNGICIDES (2) Lectures and assigned readings dealing with chemical investigations of materials used in the control of insects and plant diseases. Prerequisites: Chem. 30, 31; Agr. Biochem. 425 or Chem. 41, 43; Agr. Biochem. 417. *Professor Frear*

AGR. BIOCHEM. 517. ENDOCRINE SECRETIONS (2) Chemistry of hormones and their physiological significance. Prerequisite: Agr. Biochem. 437. *Professor Pritham*

AGR. BIOCHEM. 518. MINERAL METABOLISM (2) Utilization and function of the mineral elements in animal nutrition. Prerequisite: Agr. Biochem. 437. *Professor Boucher*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. BIOCHEM. 403. DAIRY CHEMISTRY (3) *Professor Triebold*

AGR. BIOCHEM. 404. FOOD CHEMISTRY (4) *Professor Triebold*

AGR. BIOCHEM. 405S. BIOLOGICAL CHEMISTRY FOR TEACHERS OF HIGH SCHOOL SCIENCE (3)

AGR. BIOCHEM. 413. PRINCIPLES OF ANIMAL NUTRITION (3) *Professor Miller*

AGR. BIOCHEM. 417. METHODS OF AGRICULTURAL ANALYSIS (4) *Professor Triebold*
AGR. BIOCHEM. 418. PLANT ANALYSIS (4) *Professor Jensen*
AGR. BIOCHEM. 421. CHEMISTRY OF MILLING AND BAKING (3) *Professor Triebold*
AGR. BIOCHEM. 425. BIOPHYSICAL CHEMISTRY (4) *Professor Lisse*
AGR. BIOCHEM. 426. BIOCOLLOIDS (3) *Professor Lisse*
AGR. BIOCHEM. 427. POTENTIOMETRIC THEORY AND TECHNIQUE (3) *Professor Lisse*
AGR. BIOCHEM. 437. GENERAL BIOCHEMISTRY (5) *Professor Pritham*
AGR. BIOCHEM. 438. PHYSIOLOGICAL CHEMISTRY (CLINICAL METHODS) (5) *Professors Anderson and Pritham*
AGR. BIOCHEM. 439. PROBLEMS IN AGRICULTURAL CHEMISTRY (3-5) *Professor Dutcher and Staff*
AGR. BIOCHEM. 440. PLANT BIOCHEMISTRY (3) *Professor Jensen*

AGRICULTURAL ECONOMICS

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.
Head of the Department of Agricultural Economics and Rural Sociology

AGR. EC. 500. SEMINAR IN AGRICULTURAL ECONOMICS (1-6) A review of current literature and problems.

AGR. EC. 502. ECONOMIC PROBLEMS IN THE MARKETING OF FRUITS AND VEGETABLES (3) *Professor Lee*

AGR. EC. 503. RESEARCH METHODS IN FARM MANAGEMENT (1-3) Evaluation of research procedures, methods, results, and needs in the field; emphasis on their application to specific research problems. Prerequisites: Agr. Ec. 6, Econ. 14. *Professor Barr*

AGR. EC. 504. AGRICULTURAL PRICE AND INCOME POLICY (3) Analysis of farm prices, income consequences for producers and consumers, and effects on resource use; evaluation of policy, considerations in policy making. Prerequisites: Agr. Ec. 420, Econ. 402, 403. *Professors Brandow and Cochrane*

AGR. EC. 505. ADVANCED AGRICULTURAL STATISTICS (3) Multiple correlation, curve fitting, analysis of variance, selection of samples, and other techniques applicable to the rural social sciences. Prerequisite: 3 credits in statistics. *Professor Brandow*

AGR. EC. 507. SEMINAR IN FARM MANAGEMENT (1-6) Special problems relating to the organization and operation of the farm business. Prerequisites: Agr. Ec. 6, Econ. 14.

AGR. EC. 515. ECONOMIC PROBLEMS IN THE MARKETING OF DAIRY PRODUCTS (3) Economic problems as they are encountered in the process of marketing; particular attention to governmental regulation in pricing and marketing. *Professor Pierce*

AGR. EC. 517. PROBLEMS AND POLICIES OF FARMER CO-OPERATIVES (3) Specific types of co-operative organizations, their problems, policies, and progress; relationships existing among co-operatives, between co-operatives and other business organizations, and between co-operatives and the public. Prerequisite: Agr. Ec. 17.
Professor Becker

AGR. EC. 525. RESEARCH METHODS IN RURAL SOCIAL SCIENCES (2) Scientific method in planning and conducting research. Prerequisite: 9 credits in social science.
Professor John

AGR. EC. 533. ECONOMIC PROBLEMS IN THE MARKETING OF POULTRY AND EGGS (3) Detailed treatment of special problems such as the marketing of particular types and grades of products, the operation of certain markets, and the performance of selected marketing functions. Prerequisites: Econ. 14, P.H. 1. *Professor Becker*

AGR. EC. 540. THESIS IN AGRICULTURAL ECONOMICS (6) The preparation of the required thesis for the degree of Master of Science in agricultural economics while in residence at the College.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. EC. 400, 400X. PUBLIC POLICIES IN AGRICULTURE (1-2)
AGR. EC. 404. FARM FINANCE (2) *Professor Miller*
AGR. EC. 405. STATISTICS APPLIED TO THE RURAL SOCIAL SCIENCES (3)
Professor Brandow
AGR. EC. 407. ADVANCED FARM MANAGEMENT (3) *Professor Miller*
AGR. EC. 420. AGRICULTURAL PRICES (3) *Professor Brandow*
AGR. EC. 421. LAND ECONOMICS (3)

AGRICULTURAL EDUCATION

PROFESSOR HENRY S. BRUNNER, M.S., Ph.D.
Head of the Department

AGR. ED. 501v. HISTORY OF AGRICULTURAL EDUCATION (1-3) Development of training for agricultural vocations; emphasis upon introduction of agricultural instruction into the high school program. *Professor Hall*

AGR. ED. 502v, 502vX. TEACHING VOCATIONAL AGRICULTURE (1-3) Organization of instruction with respect to vocational objectives, methods of presentation, supervision of practice, pupil evaluation of goals, and follow-up.

AGR. ED. 503v, 503vX. RESEARCH IN AGRICULTURAL EDUCATION (1-6 per semester) Individual study problems in various phases of agricultural education, such as evaluation of teaching, teaching procedures, and teacher preparation.
Professor Brunner and Staff

AGR. ED. 504v. AGRICULTURAL EDUCATION SEMINAR (1 per semester)
Professor Brunner and Staff

AGR. ED. 506v, 506vX. PROBLEMS IN COUNTY VOCATIONAL SUPERVISION (1-3) Needs of county supervisors and vocational directors; co-operation with county superintendents, supervisory duties, plans of work, community meetings and organizations. *Professor Hall*

AGR. ED. 508v. STATE AND COUNTY ADMINISTRATION AND SUPERVISION OF AGRICULTURAL EDUCATION (1-3) Organization and administration of state, county, township, and district systems of agricultural education; state and federal legislation.
Professor Brunner

AGR. ED. 509v, 509vX. TEACHER TRAINING IN AGRICULTURAL EDUCATION (1-6) Construction of college curricula, courses of study, and organization of college departments for the training of agricultural teachers. *Professor Anderson*

AGR. ED. 520v, 520vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Methods of procedure in investigation and experimentation in education, accompanied by a critical examination of studies made in agricultural education. *Professor Brunner*

AGR. ED. 521v, 521vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Continuation of Agr. Ed. 520v; emphasis upon the statistical techniques for students' individual problems. *Professor Hall*

AGR. ED. 522v, 522vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) Organization and administration of agricultural education in its local bearings; field laboratory surveys of local school conditions. *Professor Brunner and Staff*

AGR. ED. 523v, 523vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4)
Professor Brunner and Staff

AGR. ED. 524v, 524vX. ANNUAL PLAN OF WORK (1-3) A detailed study of the agricultural education needs of each student's community and the outlining of annual plans of work. *Professor Anderson*

AGR. ED. 525v. MASTER'S THESIS (1-6) Conferences and assignments in preparation of a thesis for the degree of Master of Science in agricultural education.
Professor Brunner and Staff

AGR. ED. 530v. AGRICULTURAL COLLEGE TEACHING (3) Selection and organization of subject matter for specific courses, methods of learning, teaching devices, the technique of teaching, and the measurements of the results of teaching.
Professor Brunner and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. ED. 416v. RURAL EDUCATION (3) *Professor Hall*
AGR. ED. 417v, 417vX. RURAL EDUCATION SURVEY (2) *Professor Brunner*

AGR. ED. 418v, 418vX. SURVEY OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Professor Brunner*

AGR. ED. 420v, 420vX. ADVANCED VISUAL AND OTHER SENSORY AIDS IN TEACHING AGRICULTURE (1-6) *Professor McClay*

AGR. ED. 421v. OBJECTIVES IN RURAL EDUCATION (3) *Professor Hall*

AGR. ED. 422v, 422vX. SUPERVISION OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Professor McClay*

AGR. ED. 434v, 434vX. AGRICULTURAL DEVELOPMENTS (1-6) *Mr. Stevens*

AGRICULTURAL ENGINEERING

PROFESSOR RALPH U. BLASINGAME, B.S.
Head of the Department

AGR. ENG. 500. ADVANCED ELECTRO-AGRICULTURE (1-6) Investigations in the application of electrical energy to processing, storing, and handling agricultural products. Seminar, written reports.

AGR. ENG. 501. ADVANCED FARM MACHINERY (1-6) Application of agricultural engineering principles to design and operation of farm machinery. Prerequisite: Agr. Eng. 10.

AGR. ENG. 508. ADVANCED PROBLEMS IN FARM MECHANICS (1-15) Problems in farm shop practice and agricultural engineering related to the farm mechanics program of vocational education in agriculture. Prerequisites: Agr. Eng. 8, 14; or teaching experience in farm mechanics.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. ENG. 400. AGRICULTURAL ENGINEERING PROBLEMS AND SEMINAR (1-7)

AGR. ENG. 401a,b,c,dS. FARM MECHANICS FOR THE TEACHER OF VOCATIONAL AGRICULTURE (1½-6)

AGR. ENG. 402. FUNCTIONAL DESIGN OF FARM STRUCTURES (3)

AGR. ENG. 405. ADVANCED FARM ELECTRIFICATION (3)

AGR. ENG. 406. ADVANCED DAIRY ENGINEERING (3)

AGRONOMY

PROFESSOR HERBERT R. ALBRECHT, M.S., Ph.D.
Head of the Department

AGRO. 501. ADVANCED SOIL FERTILITY (4) Interpretation of fertility experiments and diagnosis of soil-plant relationships through field appraisal, analysis, and plant symptoms. Prerequisites: Agro. 431, Bot. 406. *Professor Merkle*

AGRO. 503. AGRONOMY SEMINAR (1) A weekly meeting where papers and discussions will be presented by students and staff members. Each student will present a paper on some phase of his major subject.

AGRO. 506. SOIL CHEMISTRY (4) Analyses of the important chemical and biochemical reactions occurring in soils, the conditions which control these reactions and their importance in soil genesis and plant growth; laboratory work in the more typical and significant analytical procedures; lectures, review of current literature, and practicum. Prerequisites: Agro. 419; Agr. Biochem. 417 or Chem. 20. *Professor Steckel*

AGRO. 507. SOIL PHYSICS (4) Physical properties of the soil; factors affecting them; their measurements, evaluation, and influence in the determination of soil productivity. Prerequisites: Agro. 419, Phys. 215, Agr. Biochem. 425.
Professor Alderfer

AGRO. 509. GENETICS OF CROP PLANTS (3) The inheritance in crop plants with particular reference to factor interaction, the genetic aspects of linkage and crossing-over, quantitative inheritance, and heterosis. Prerequisite: Bot. 423.
Professor Carnahan

AGRO. 510. THE APPLICATION OF CYTOGENETICS TO PLANT BREEDING (3) Cytogenetics, including chromosome structure and behavior, chromosome alterations, polyploidy, interspecific hybridization and their applications to plant breeding. Prerequisite: Bot. 505. *Professor Carnahan*

AGRO. 511. THE BREEDING OF FARM CROPS (3) The application of genetic principles to the improvement of crop plants. Prerequisite: Hort. 7.

AGRO. 512. FIELD PLOT TECHNIQUE (3) The design and analyses of field experiments. Prerequisites: Math. 8, Com. 90, or Agr. Ec. 505. *Professor Fortmann*

AGRO. 516. HUMUS (2) The origin and chemical nature of soil organic matter, its importance in soil processes, and its decomposition. Prerequisites: Agro. 419, 431. *Professor Richer*

AGRO. 517. FARM CROPS ECOLOGY (2) The ecological factors influencing the distribution and production of field crops. Prerequisites: Math. 8, Bot. 406.
Professor Huber

AGRO. 518. GROWTH AND MANAGEMENT OF FORAGE CROPS (3) Factors affecting growth and development of forage crops with particular reference to the effects of environment, defoliation, and management practices. Prerequisites: Agro. 423, Bot. 406. *Professor Sprague*

AGRO. 520. SPECIAL SOILS PROBLEMS (1-6 per semester) Provides basic or practical training in the soils sciences by means of library, field, and laboratory assignments.

AGRO. 545. THE APPLICATION OF STATISTICS TO FIELD EXPERIMENTS (3) Experimental designs useful in planning field experiments. Confounding: lattice, fac-

torial, and randomized block designs; analysis of variance and co-variance. Prerequisite: Agro. 512. *Professor Fortmann*

AGRO. 550. SPECIAL CROPS PROBLEMS (1-6 per semester) Provides basic or practical training in the crops sciences by means of library, field, and laboratory assignments.

AGRO. 582. SEMINAR IN BREEDING AND GENETICS OF FARM CROPS (1-8 per semester)

AGRO. 583S. LABORATORY METHODS IN FIELD CROPS (3) Prerequisite: Agro. 512. *Professor Carnahan*

AGRO. 591. THESIS RESEARCH (1-15 per semester) Thesis research in the various crops and soils sciences falling within the research program of the department.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGRO. 402.	THE NATURE OF SOIL MINERALS (3)	*Professor Jeffries*
AGRO. 416.	THE CLASSIFICATION AND MAPPING OF SOILS (4)	*Professor Higbee*
AGRO. 419.	SOIL PROPERTIES (5)	*Professor Merkle*
AGRO. 422.	SOIL CONSERVATION (3)	*Professor Alderfer*
AGRO. 423.	PASTURE AND GRASSLAND MANAGEMENT (3)	*Professor Washko*
AGRO. 431.	SOIL FERTILITY AND MANAGEMENT (3)	*Professor Merkle*
AGRO. 444.	FIELD PLOT TECHNIQUE (3)	*Professor Fortmann*
AGRO. 490.	AGRONOMIC PRACTICES (1-6)	

ANIMAL HUSBANDRY

PROFESSOR FRANKLIN L. BENTLEY, M.S.
Head of the Department

A.H. 501. PEDIGREE STUDY (1-6) Research work in breed study history, and analytical study of breed pedigrees, and a complete survey of the herd, flock, or stud book. *Professor Henning*

A.H. 502. RESEARCH IN MEATS (1-6 per semester) Investigation of methods for handling, cutting, processing, freezing, and curing meat and meat products. Prerequisite: A.H. 421. *Professor Ziegler*

A.H. 503. LIVESTOCK MANAGEMENT (3) The handling of purebred herds and flocks; the relation of the livestock breeders to the public and methods of developing purebred herds and flocks through careful breeding.
Professor Bentley and Staff

A.H. 504. LIVESTOCK HEALTH PROBLEMS (3) Problems dealing with the regulations governing the movement of livestock with special reference to control

measures applicable to diseases and disease groups common to men and animals. Prerequisites: A.H. 5, 415.

A.H. 505. Advanced Animal Breeding (1-5) Special problems in animal genetics as applied to breeding and improvement of horses, cattle, sheep, and swine. Prerequisites: A.H. 22, Bot. 22. *Professor Henning*

A.H. 506. Research in Animal Husbandry (2-10 per semester) The prosecution of an assigned problem under the guidance of an instructor. Prerequisites: A.H. 415, 421; or 426.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

A.H. 415. Advanced Anatomy and Physiology (3)
A.H. 421. Advanced Meat Studies (3) *Professor Ziegler*
A.H. 423. Advanced Stock Judging (2) *Professor Henning*
A.H. 424. Animal Husbandry Survey (1) *Professor Bentley and Staff*
A.H. 426. Livestock Markets and Marketing (3) *Professors Bentley and Henning*
A.H. 428. Advanced Animal Nutrition (3) *Professor Bentley and Staff*
A.H. 431. Advanced Meat Judging (1)

ANIMAL NUTRITION

Professor Raymond W. Swift, M.S., Ph.D.
Head of the Department

An. Nutr. 500. Research in Animal Nutrition (Credit to be arranged) Participation in the research program of the Department of Animal Nutrition and independent investigation. The available facilities make it possible to accommodate only a small number of students.

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

An. Nutr. 401. Physiology of Nutrition (3) *Professor Black*
An. Nutr. 402. Physiology of Nutrition (3) *Professor French*

ARCHITECTURAL ENGINEERING

Consult Professor Louis A. Richardson, M.S.

A.E. 502. Architectural Engineering (3-8) Advanced structural design in steel and reinforced concrete. Lectures and class criticism. Practicum and seminar. *Professor Richardson and Staff*

A.E. 503. Architectural Engineering (4-8) Continuation of A.E. 502 in which problems of wind bracing in tall buildings, rigid frames, and heavy-framed construction are studied. Practicum and seminar. *Professor Fox*

A.E. 504. Architectural Engineering (4-8) Statically indeterminate stresses in steel and reinforced concrete buildings; area moment, slope deflection, and moment distribution methods. Recitation and seminar.
Professor Richardson and Staff

A.E. 505. Architectural Engineering (4-8) Continuation of A.E. 504. Recitation and seminar. *Professor Richardson*

A.E. 506. Architectural Engineering Research (1-15) The presentation of an assigned problem under the guidance of an instructor.
Professors Richardson and Fox

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

A.E. 401. Architectural Engineering (3)
A.E. 402. Architectural Engineering (4)
A.E. 403. Architectural Engineering (3)
A.E. 404. Architectural Engineering (4) *Professor Fox*
A.E. 405. Architectural Engineering (4) *Professor Richardson*
A.E. 406. Architectural Engineering (4) *Professor Fox*
A.E. 407. Architectural Engineering (3) *Professor Richardson*
A.E. 410. Architectural Engineering (3) *Professor Richardson*
A.E. 411. Architectural Engineering (3) *Professor Fox*

ARCHITECTURE

Professor Milton S. Osborne, M.S.
Head of the Department

Arch. 501. Architectural Design (4-8) Problems in advanced planning and design, including study of group composition. Practicum and seminar.
Professor Osborne and Staff

Arch. 502. Architectural Research (2-12) The prosecution of assigned problems under the guidance of an instructor. *Professor Osborne and Staff*

Arch. 503. Architectural History Research (3-12) Original research in architectural history. Seminar and written reports. *Professor Dickson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Arch. 406. Advanced Architectural Design (7) *Professor Osborne and Staff*
Arch. 407. Advanced Architectural Design (7) *Professor Osborne and Staff*

ARCH. 410. ADVANCED ARCHITECTURAL DESIGN (2-12) *Professor Osborne and Staff*
ARCH. 421. CONTEMPORARY ARCHITECTURE (3) *Professor Norton*

ART

PROFESSOR MILTON S. OSBORNE, M.S.
Head of the Department of Architecture

(See also courses in Art Education below.)

ART 500. ART RESEARCH (2-6) The prosecution of assigned problems under the guidance of an instructor. *Professor Galbraith*

ART 501. ITALIAN PAINTING (2-6) Investigations in the field of early Italian painting. Seminar, written reports. *Professor Dickson*

ART 502. MEDIEVAL SCULPTURE (2-6) Sculpture of Italy and France from the 9th to the 13th centuries. Seminar, written reports. *Professor Dickson*

ART 503. ART HISTORY RESEARCH (3-12) Original investigation in art history, to be pursued independently or concurrently with course work in particular fields. Prerequisite: 6 credits in history of art. *Professor Dickson and Staff*

ART 504. SEMINAR: ART LITERATURE AND ICONOGRAPHY (2-6) Methods of research in the fine arts; survey of the literature of art; studies in iconography. Prerequisite: 6 credits in history of art. *Professor Dickson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ART 400. OIL PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9)
ART 403S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Professor Dickson*
ART 404S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Professor Dickson*
ART 410. WATER-COLOR PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9) *Professor Case*
ART 442S. ART OF THE MIDDLE AGES AND RENAISSANCE IN ITALY (3)
ART 443S. ART IN AMERICA (3)
ART 444S. ART IN NORTHERN EUROPE (3)
ART 490. LIFE DRAWING (3) *Professor Case*

ART EDUCATION

Consult PROFESSOR VIKTOR LOWENFELD

ART ED. 514. FUNCTIONAL RELATIONSHIPS IN CRAFTS (3) Relationships of material design and purpose in crafts discussed by means of outstanding products of differ-

ent materials, periods, and cultures. Prerequisite: 6 credits in crafts or 3 in design and 3 in advanced crafts.

ART ED. 534. CREATIVE ART ACTIVITY FOR THE HANDICAPPED (3) Specific methods for development of creative art activity with the physically, mentally, emotionally, and socially handicapped; adjustive effect upon them. Prerequisite: 6 credits in art education or 6 in special education. *Professor Lowenfeld*

ART ED. 586. RESEARCH IN ART EDUCATION (3-9) Current experiments in art education; required of students working for a master's degree in art education. *Professor Lowenfeld*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ART ED. 402. METHODS OF TEACHING DRAWING IN THE GRADES (2-3) *Professor Emerson*
ART ED. 404. METHODS OF GRAPHICS AND ILLUSTRATIONS (3)
ART ED. 414. ADVANCED CRAFTS FOR TEACHERS (3-6) *Professor Emerson*
ART ED. 434. ART APPRECIATION IN THE EDUCATIONAL PROGRAM (2-3)
ART ED. 434b, 434bX. ART IN THE ELEMENTARY SCHOOL (2-3) *Professor Lowenfeld*
ART ED. 434c, 434cX. ART IN THE SECONDARY SCHOOL (2-3) *Professor Lowenfeld*
ART ED. 434d. ART SUPERVISION (3) *Professor Lowenfeld*
ART ED. 486, 486X. CURRENT PROBLEMS IN ART EDUCATION (2-3) *Professor Lowenfeld*
ART ED. 487. MURAL PAINTING IN SCHOOLS (3) *Professor Lowenfeld*
ART ED. 488. ADVANCED MURAL PAINTING IN SCHOOLS (3) *Professor Lowenfeld*

BACTERIOLOGY

PROFESSOR ROBERT W. STONE, Ph.D.
Head of the Department

BACT. 504. DAIRY BACTERIOLOGY PROBLEMS (2-15) Research on the microorganisms of importance in dairy sanitation, miik production, and manufacture of dairy products. Prerequisite: 12 credits in bacteriology.

BACT. 505. PATHOGENIC BACTERIOLOGICAL PROBLEMS (2-15) Problems on the morphological, cultural, and immunological characteristics of pathogenic bacteria. Prerequisite: 12 credits in bacteriology.

BACT. 506. RESEARCH (2-15) Research in bacteriology for students who are doing their major work in this subject for the master's or doctor's degree. Prerequisite: 12 credits in bacteriology.

BACT. 507. BACTERIOLOGICAL SEMINAR (1-6) Reports on current fields of research. Prerequisite: 12 credits in bacteriology.

Bact. 508. Physiology of Bacteria (2) Metabolic processes of bacteria as influenced by their environment; the mechanism of fermentation and respiration of microorganisms. Prerequisite: Bact. 412.

Bact. 508a. Laboratory in Physiology of Bacteria (2) Laboratory work to accompany the lectures given in Bact. 508. Prerequisite: Bact. 412.

Bact. 509. Fermentation (2) The chemical action of microorganisms on their environment; theories of carbohydrate breakdown and the application of these theories to industrial and agricultural fermentations. Prerequisites: Bact. 1, Chem. 31.

Bact. 510. Methods and Analyses in Bacterial Fermentation (2) Laboratory procedures and problems in fermentation to accompany Bact. 509. Prerequisites: Bact. 1, Chem. 31.

Bact. 511. Bacteriological Literature (2-4) Assigned reading and conferences dealing with a student's research problem. May be taken only in those instances where a student is not scheduling Bact. 504, 505, or 506. Discussion and written reports. Prerequisite: 12 credits in bacteriology.

Bact. 512. Laboratory in Advanced Bacteriological Techniques (2-6) Certain techniques used in research including work with single cell isolation, Warburg apparatus, tissue culture and serology. May be repeated with credit. Prerequisite: 12 credits in bacteriology.

Bact. 515. Pathogenic Bacteriology and Virology (3-6) Important bacterial, rickettsial, and viral agents parasitizing man and animals; immunological and epidemiological considerations of host response. Prerequisite: Bact. 410.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Bact. 401. General Microbiology (4)
Bact. 407. Bacteriology Problems (2-9)
Bact. 410. Immunology and Serology (4)
Bact. 411. Bacteriological Survey (1)
Bact. 412. Advanced Bacteriology (4)
Bact. 413. Soil Microbiology (3)
Bact. 414. Food Microbiology (4)
Bact. 416. Industrial Microbiology (4)

BOTANY

Professor Henry W. Popp, M.S., Ph.D.
Head of the Department

Bot. 501. The Physiology of the Fungi (3) The metabolism of the fungi, general and special nutrition, chemical composition, enzymes, spore germination,

toxic and stimulating agencies, growth and tropism, etc. Prerequisites: Bot. 406, 419, and, preferably, Chem. 32. *Professor Fergus*

Bot. 502. The Ascomycetes (3) The morphology, life histories, taxonomy, and physiology of the ascomycetous fungi. Prerequisite: Bot. 419.

Bot. 503. The Rusts and Smuts (3) The morphology, life histories, taxonomy, and phylogeny of the rusts and smuts. Prerequisite: Bot. 419.

Bot. 504. The Higher Basidiomycetes (3) The structures, habits, taxonomy, and relationships of the various groups of higher basidiomycetes. Prerequisite: Bot. 419.

Bot. 505. Cytology and Cytogenetics (3) Cells and their components; nuclear and cell divisions; syngamy, chromosomal aberrations and heteroploidy in relation to genetics and evolution. Prerequisites: Bot. 22 or 32, and 421. *Mr. Wright*

Bot. 506. Comparative Anatomy of Vascular Plants (3) The special anatomical features of pteridophytes, gymnosperms, and angiosperms. Prerequisites: Bot. 7, 415, 416. *Professor Kribs*

Bot. 507. Variation and Selection (3) Variation and the results of selection in pure lines and clones involving the collection, interpretation, and analysis of data by biometrical means. Prerequisites: Bot. 22 or 32, and 423.

Bot. 508. Problems of Heredity (2-6) Problems in genetics selected to suit the needs and accomplishments of individual students. Prerequisites: Bot. 22 or 32, 422 or 423.

Bot. 509. The Physiology of Parasitism (3) The conditions and processes of infection, diseases, and death in plants as caused by parasitic organisms. Prerequisite: Bot. 10, 11, or 419. *Professor Thurston*

Bot. 510. Plant Pathological Problems (3-6) Special diseases or disease groups, such as bacterial or mosaic diseases, etc. Prerequisite: Bot. 10 or 11. *Professor Thurston*

Bot. 511. Growth and Movement (2-4) The physiology of growth with special reference to the influence of external and internal factors upon growth, development, and movement of plants. Prerequisite: Bot. 406. *Professor Popp*

Bot. 512. Plant Metabolism (2-4) The physiological processes involved in the metabolism of plants; alternates with Bot. 511. Prerequisite: Bot. 406. *Professor Popp*

Bot. 514. Cytotaxonomy (2) Cytological features of plant phylogeny with special reference to the number and morphology of the chromosomes and related phenomena. Prerequisites: Bot. 414, 505. *Professor Wahl*

Bot. 515. Disease Resistance and Its Inheritance (2-4) An introduction to disease resistance as a method of plant disease control. Prerequisites: Bot. 22 or 32, 10. *Professors Wernham and Mills*

Bot. 517. The Fungi Imperfecti (3) The morphology, life histories, and taxonomy of the fungi imperfecti. Prerequisite: Bot. 419.

Bot. 518. Botanical Research (1-15 per semester) The prosecution of an assigned problem under the guidance of an instructor.

Bot. 527aS, 527bS. Foundations of Plant Biology (3 per course) Cellular structure and organization with consideration of the physiological and reproductive processes in so far as these form the basis of plant life. Bot. 527a and 527b will be offered in alternate years. In the former emphasis will be on cellular structure and physiology, in the latter on racial preservation and development and relationship of plant groups. Prerequisite: general biology or general botany courses.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Bot. 406.	Plant Physiology (4)	*Professor Popp*
Bot. 407.	Plant Anatomy (3)	*Professor Kribs*
Bot. 408.	General Plant Pathology (3)	
Bot. 409S.	Plant Ecology (3)	
Bot. 412.	Advanced Forest Pathology (3)	
Bot. 414.	Systematic Botany (3)	*Professor Wahl*
Bot. 415.	Morphology of the Algae (3)	*Professor Wahl*
Bot. 416.	Morphology of the Bryophytes and Pteridophytes (3)	*Professor Grove*
Bot. 418.	Botanical Problems (1-6)	
Bot. 419.	Mycology (3)	*Professor Fergus*
Bot. 420.	Morphology of the Seed Plants (3)	*Professor Grove*
Bot. 421.	Botanical Technique (3)	*Professor Grove*
Bot. 422.	Genetic Phenomena (3)	*Mr. Wright*
Bot. 423.	Advanced Genetics (2-6)	
Bot. 424.	Commercial Tropical Woods (3)	*Professor Kribs*
Bot. 425.	Structure of Economic Plants (3)	*Professor Grove*
Bot. 426.	Photomicrography (2)	
Bot. 432S.	Genetics, Eugenics, and Evolution (3)	

CERAMICS

Professor Edward C. Henry, M.S., Cer.E., Ph.D.
Chief of the Division

Cer. 500. Ceramics Seminar (1 per semester) Conferences, reading, and reports. Required of all graduate students in ceramics. Prerequisites: Chem. 41, Phys. 285.
Professor Henry and Staff

Cer. 501. Ceramics Research (1-15 per semester) Laboratory study on special ceramic problems. *Professor Henry and Staff*

CER. 502. HEAT TREATMENT OF CERAMIC MATERIALS (2-5) Effect of controlled heat treatment on physical and chemical properties of various mineral systems.

CER. 503. CONSTITUTION OF GLASS (2-4) An advanced course on glass dealing with the latest developments in the structure of viscous liquids and transparent amorphous solids. Prerequisite: Cer. 415. *Professor Weyl*

CER. 504. RESEARCH INSTRUMENTS AND EQUIPMENT (2) Application of fundamental laws and principles in research instruments; care, adjustment, and effective use of instruments and equipment (demonstrations). Prerequisite: Cer. 411.

CER. 505. GLASS TECHNOLOGY RESEARCH (1-15 per semester) Laboratory studies on special problems concerning the properties, constitution, and manufacture of glass. Prerequisite: Cer. 415. *Professor Weyl and Staff*

CER. 506. GLASS TECHNOLOGY SEMINAR (1-6) Group discussion of special advanced topics concerning the properties and manufacture of glass. Prerequisite: Cer. 415.

CER. 507. COLORING AND DECOLORIZING GLASS (1) Physical-chemical considerations of the various coloring oxides; oxidation-reduction equilibria pertaining to coloring and decolorizing of glass. Prerequisite: Cer. 415. *Professor Weyl*

CER. 508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2-3) Colloidal activity in bodies, glazes, and enamels, drilling fluids, filtering and bleaching clays, and similar mineral systems. (In co-operation with the Petroleum and Natural Gas staff.) Prerequisite: Chem. 41. *Professor Henry*

CER. 509. SILICATE SYSTEMS (3) The properties of silica; classification of silicates; reactions in binary and ternary systems; industrial applications of the phase rule. Prerequisites: Chem. 41, Cer. 303. *Professor Matson*

CER. 510. CERAMIC PROBLEMS (1-6 per semester) Advanced individual study on a problem in some branch of ceramics, including review of the literature and a full report. Prerequisite: Cer. 411. *Professor Henry and Staff*

CER. 511. SELECTED TOPICS IN CERAMICS (1-3 per semester) Intensive group study of special subjects, such as diffusion in solids, viscosity, and kinetics of ceramic processes. Prerequisites: Chem. 41, Phys. 285. *Professor Henry and Staff*

CER. 512. SYNTHESIS OF CERAMIC COMPOUNDS (3) Advanced ceramic technology applied to the control of phases formed in commercial production of glass, whitewares, refractories, and cements. Prerequisites: Chem. 41, Cer. 303.
Professor Hummel

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CER. 400. SPECIAL TOPICS (1-2)
CER. 401. CERAMIC BODIES AND GLAZES (3) *Professor Hummel*
CER. 402. PRINCIPLES OF CERAMIC ENGINEERING (3) *Professor Henry*
CER. 403. CERAMIC ENGINEERING PROCESSES AND EQUIPMENT (3) *Professor Ehman*
CER. 404. CERAMICS SEMINAR (1) *Professor Henry and Staff*

CER. 405. CERAMIC RESEARCH AND DESIGN (3) *Professor Henry and Staff*
CER. 411. THEORY OF CERAMIC PROCESSES (2)
CER. 413, 413X. CERAMIC PETROGRAPHY (3) *Professor Matson*
CER. 415. GLASS AND ENAMELS (3) *Professor Ehman*
CER. 416. ADVANCED GLASS TECHNOLOGY (3) *Professors Weyl and Rindone*
CER. 420. REFRACTORIES (3) *Professor Matson*

CHEMICAL ENGINEERING

PROFESSOR DONALD S. CRYDER, M.S., D.Sc.
Head of the Department

CHEM. ENG. 500. SEMINAR IN CHEMICAL ENGINEERING (1) Required of all graduate students.

CHEM. ENG. 510. ADVANCED HEAT TRANSFER I (3) The physical and chemical factors controlling the rate of heat transfer under conditions of steady flow. *Professor Cryder*

CHEM. ENG. 511. ADVANCED HEAT TRANSFER II (3) Flow of heat under varying temperature conditions. *Professor Cryder*

CHEM. ENG. 513. DIFFUSION (2) The factors controlling diffusional operations such as absorption, extraction, humidification, etc. *Professor Carnahan*

CHEM. ENG. 515. DISTILLATION (3) Commercial distillation, equilibrium diagrams, vapor composition, stills and rectifying and stripping columns. *Professor Carnahan*

CHEM. ENG. 516. ECONOMIC BALANCE (3) Problem work on the design of chemical engineering equipment from the economic standpoint. *Professor Cannon*

CHEM. ENG. 518. CHEMICAL ENGINEERING DESIGN (3) Complicated examples are discussed and worked out. Several different unit operations will be combined for the design of a complete installation. *Professor Cryder*

CHEM. ENG. 519. CHEMISTRY OF COMBUSTION (3) The physical and chemical characteristics of combustion and their influence on plant scale equipment. *Professor Cryder*

CHEM. ENG. 524. CHEMICAL ENGINEERING, APPLICATION OF THERMODYNAMICS (3) Elements of thermochemistry and thermodynamics of greatest importance in chemical engineering. *Professor Cannon*

*CHEM. ENG. 580. RESEARCH IN PETROLEUM REFINING (3-15) Charge will be made for supplies consumed and breakage of equipment. *Professors Fenske, Carnahan, and Quiggle*

* Credits to be arranged, 3 to 15 per semester.

†Chem. Eng. 599. Research in Chemical Engineering (1-15) Charge will be made for supplies consumed and breakage of equipment.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Chem. Eng. 402. Chemical Engineering (4) *Professor Carnahan*
Chem. Eng. 403. Chemical Engineering (4) *Professor Carnahan*
Chem. Eng. 421. Petroleum Products (4) Breakage ticket $3. *Professors Carnahan, Cryder, and Cannon*
Chem. Eng. 422. Motor Fuels (2) *Professor Carnahan*
Chem. Eng. 423. Lubricants (2) *Professor Carnahan*
Chem. Eng. 425. Standard Tests of Petroleum and Its Products (1) Breakage ticket $2. *Professors Carnahan, Cryder, and Cannon*

CHEMISTRY

Professor W. Conard Fernelius, M.A., Ph.D.
Head of the Department

Chem. 500. Seminar in Inorganic, Micro, and Household Chemistry (1)

Chem. 501. Seminar in Physical Chemistry (1)

Chem. 502. Seminar in Organic Chemistry (1)

Chem. 503. Seminar in Analytical Chemistry (1)

Chem. 515. Inorganic Chemistry (2) Adapted to the needs of those desiring a general treatment of inorganic chemistry at an advanced level. *Professor Holtzinger*

Chem. 516. Systematic Inorganic Chemistry (3) A systematic treatment of inorganic chemistry in terms of modern concepts. *Professors Fernelius and Douglas*

Chem. 517. Chemistry of the Less Familiar Elements (3) Continuation of Chem. 516. *Professors Fernelius and Douglas*

Chem. 518. Special Topics in Inorganic Chemistry (3 per semester) Modern developments in specialized fields.

Chem. 525. Analytical Chemistry (3) Analytical principles as applied to the analysis of inorganic and organic substances. *Professor Elving*

Chem. 526. Advanced Analytical Chemistry (3) Theory and practice of contemporary analytical chemistry as used in chemical research and plant operation. *Professor Elving*

† Credits to be arranged, 1 to 15 per semester.

CHEM. 527. SPECIAL TOPICS IN ANALYTICAL CHEMISTRY (2-12) Currently used techniques in analytical chemistry.

CHEM. 531. SPECIAL TOPICS IN ORGANIC CHEMISTRY (3) May be taken for credit for four successive semesters.

CHEM. 531a. ORGANOMETALLIC CHEMISTRY (3) An intensive coverage of the chemistry of organometallic compounds and their use in organic syntheses.
Professor Sommer

CHEM. 532. ORGANIC NITROGEN COMPOUNDS (3) Chemistry, stereochemistry, and molecular structure of organic compounds containing nitrogen. *Professor Aston*

CHEM. 533. TERPENES (3) The terpenes and their more important derivatives with special reference to the application of the principles of aliphatic chemistry.

CHEM. 534. THEORETICAL ORGANIC CHEMISTRY (3) Modern theories of structure; resonance; interpretation of physical properties; theory of rates; equilibrium properties. *Professor Aston*

CHEM. 535. ORGANIC CHEMISTRY (3) Adapted to the needs of those doing research work in organic chemistry. *Professor Zook*

CHEM. 536. ORGANIC CHEMISTRY (3) Continuation of Chem. 535.
Professor Zook

CHEM. 538. ORGANIC CHEMISTRY (3) A survey of organic chemistry arranged primarily for graduate students majoring in fields other than organic chemistry.
Professor Noll

CHEM. 539. STEREOCHEMISTRY (3) A comprehensive treatment of the principles of stereochemistry as applied to organic compounds. *Professor Oakwood*

CHEM. 541. PHASE RULE (3) The phase rule and its applications. Given 1950-51 and in alternate years thereafter. *Professor Currier*

CHEM. 542. COLLOIDS (3) The physics and chemistry of surfaces and their resulting colloid properties. Methods of preparing colloids.

CHEM. 543. RHEOLOGY OF COLLOIDS (3) Continuation of Chem. 542. Rheology, especially as applied to colloids and similar substances.

CHEM. 544. CHEMICAL THERMODYNAMICS (3) Development of thermodynamic theory with special reference to common physical changes and chemical reactions. Prerequisite: Chem. 441 or 562. *Professor Aston*

CHEM. 545. CHEMICAL THERMODYNAMICS AND INTRODUCTORY STATISTICAL MECHANICS (3) Continuation of Chem. 544 including the calculation of thermodynamic properties from molecular and spectroscopic data. Prerequisite: Chem. 544.
Professor Aston

CHEM. 546. QUANTUM CHEMISTRY (3) Theory of energy levels in atoms and molecules from the standpoint of wave mechanics with special emphasis on the

portion of the subject applying to common chemical systems. Prerequisite: Chem. 441 or 562. Given alternate years only. *Professor Aston*

CHEM. 547. STATISTICAL MECHANICS (3) Properties of matter at equilibrium, developed on the basis of energy levels of molecules and statistical mechanical theory. Prerequisite: Chem. 546. Given alternate years only. *Professor Aston*

CHEM. 548. CATALYSIS (3) The theory of catalysis and its application to industry. Given 1951-52 and in alternate years thereafter. *Professor Currier*

*CHEM. 550. RESEARCH IN HOUSEHOLD CHEMISTRY (1-15) Charge will be made for supplies consumed and breakage of equipment. *Professor Mack*

CHEM. 561. CHEMICAL PRINCIPLES (3) A mathematical treatment of the classical principles of chemistry; their application to problems. Required of all graduate students. Prerequisites: Chem. 41, Math. 11, Phys. 285. A course in organic chemistry is recommended. *Professor Aston*

CHEM. 562. CHEMICAL PRINCIPLES (3) Continuation of Chem. 561. Required of all graduate students. *Professor Aston*

CHEM. 563. CHEMICAL KINETICS (3) The theory and measurement of the rates of chemical reactions; the mechanism of chemical reactions. *Professor Simons*

CHEM. 564. CHEMICAL KINETICS (3) Continuation of Chem. 563 but including the theory and measurement of photochemical reactions. *Professor Simons*

CHEM. 565. ATOMIC AND MOLECULAR STRUCTURE (3) The structure of chemical species and the correlation of experimentally determined properties by structural theory. *Professor Simons*

CHEM. 566. ATOMIC AND MOLECULAR STRUCTURE (3) Continuation of Chem. 565. *Professor Simons*

CHEM. 567. ADVANCED THEORETICAL CHEMISTRY (3) Modern and current theories of the properties of chemical substances and their applications to chemical problems; the construction of chemical theory. *Professor Simons*

CHEM. 568. ADVANCED THEORETICAL CHEMISTRY (3) Continuation of Chem. 567. *Professor Simons*

*CHEM. 580. RESEARCH IN PETROLEUM REFINING (1-15) Charge will be made for supplies consumed and breakage of equipment. *Professor Fenske*

*CHEM. 599. RESEARCH IN CHEMISTRY (1-15) Charge will be made for supplies consumed and breakage of equipment.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CHEM. 400. CHEMICAL LITERATURE (1) *Miss Jackson*
CHEM. 411. FLUORINE CHEMISTRY (3) *Professor Simons*

* Credits to be arranged, 1-15 per semester.

CHEM. 412. FLUORINE CHEMISTRY (3) *Professor Simons*

CHEM. 413. INORGANIC PREPARATIONS AND LABORATORY METHODS (2-5) *Professor Douglas*

CHEM. 426. ADVANCED QUALITATIVE AND QUANTITATIVE ANALYSIS (3-5) Breakage ticket $10. *Professor Hayes*

CHEM. 434. QUANTITATIVE ORGANIC ANALYSIS (3-5) Breakage ticket $10 for 3 credits, $12 for 4 or 5 credits. *Professor Higgins*

CHEM. 435. ORGANIC PREPARATIONS AND LABORATORY METHODS (3-5) Breakage ticket $10 for 3 credits, $12 for 4 or 5 credits. *Professor Higgins*

CHEM. 436. ORGANIC CHEMISTRY OF NATURAL PRODUCTS (3) *Professor Aston*

CHEM. 437. QUALITATIVE ORGANIC ANALYSIS (3) Breakage ticket $4. *Professor Olewine*

CHEM. 438. INTRODUCTION TO RESEARCH IN ORGANIC CHEMISTRY (2-5) Breakage ticket $10 for 2 or 3 credits, $12 for 4 or 5 credits. *Professor Higgins*

CHEM. 440. ADVANCED PHYSICAL CHEMISTRY (3) *Professors Hutchison and Seward*

CHEM. 441. ADVANCED PHYSICAL CHEMISTRY (3) *Professors Hutchison and Seward*

CHEM. 448. COLLOID CHEMISTRY (3) Breakage ticket $3. *Professor Hutchison*

CHEM. 453a-h. RECENT ADVANCES IN TEXTILE CHEMISTRY (1-8)

CHEM. 470. CHEMICAL MICROSCOPY (3) Breakage ticket $2. *Professor Willard*

CHEM. 471. ADVANCED CHEMICAL MICROSCOPY (3) Breakage ticket $2. *Professor Willard*

CHEM. 472. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket $2. *Professor Fleming*

CHEM. 473. TEXTILE MICROSCOPY (3) Breakage ticket $2. *Professor Willard*

CHEM. 474. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket $2. *Professor Fleming*

CHEM. 475. INTRODUCTION TO CHEMICAL SPECTROSCOPY (3) Breakage ticket $2. *Professor Schempf*

CHEM. 476. MICROSCOPIC MICROTECHNIQUE (3) Breakage ticket $2. *Professor Willard*

CHEM. 477. PAPER MICROSCOPY (3) Breakage ticket $2. *Professor Willard*

†CHEM. 490. ORGANIC CHEMISTRY (5) Breakage ticket $4. *Professor Olewine*

†CHEM. 491. ORGANIC CHEMISTRY (5) Breakage ticket $12. *Professor Olewine*

†CHEM. 492a. ADVANCED GENERAL CHEMISTRY (3) Breakage ticket $3. *Professor Currier*

†CHEM. 496. GENERAL PHYSICAL CHEMISTRY (3) *Professor Seward*

†CHEM. 497. GENERAL PHYSICAL CHEMISTRY (2) *Professor Seward*

†CHEM. 498. PHYSICOCHEMICAL MEASUREMENTS (1) Breakage ticket $6. *Professor Ascah*

†CHEM. 499. PHYSICOCHEMICAL MEASUREMENTS (1) Breakage ticket $6. *Professor Ascah*

† Candidates for the M.Ed. degree.

CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS

PROFESSOR WINONA L. MORGAN, M.A., Ph.D.
Head of the Department

CH. FAM. 500. RESEARCH IN CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (1-6 per semester)

CH. FAM. 501. THESIS (1-15)

CH. FAM. 508. PARENTAL EDUCATION (3) Discussion and use of methods, experiences, and programs which can be used effectively to help parents in dealing with problems of parent-child relationships. Prerequisites: Ch. Fam. 429, 430.
Professor Morgan

CH. FAM. 515, 515X. THE TEACHING OF CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (3) Methods of selection and presentation of subject matter basic to understanding the development of children, and the attitudes, emotions, and relationships within the family. Not open to students having credit for Ch. Fam. 482. Prerequisite: 6 credits in child development and family relationships.
Professor Morgan

CH. FAM. 536. CHILDREN IN POSTWAR FAMILIES AND COMMUNITIES (3) Postwar family and community situations influencing the development of children; the role of parents and teachers in helping individual children make satisfactory adjustments. Prerequisites: Ch. Fam. 429, 430, or 2 courses in psychology.
Professor Morgan

CH. FAM. 540. SEMINAR IN CHILD DEVELOPMENT (1-6) Readings and reports on recent findings in child development. Prerequisites: Ch. Fam. 429, 430, or Psy. 411, or 425. *Professor Morgan*

CH. FAM. 545, 545X. THE FAMILY IN ITS COMMUNITY (2-3) Cultural influences on family relationships; how the family orients its members to community living and group participation. Prerequisites: Soc. 1, Ch. Fam. 405; Rur. Soc. 452 or Psy. 419. *Professor Smith*

CH. FAM. 546. SEMINAR IN FAMILY RELATIONSHIPS (1-3) Reading, reports, and discussion of recent research in relationship aspects of family living; particular attention to studies of roles, crises, and adjustments within the family setting. Prerequisite: Ch. Fam. 405 or 6 hours of sociology or psychology.
Professor Smith

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CH. FAM. 405. MARRIAGE AND FAMILY RELATIONSHIPS (3) *Professor McDowell*
CH. FAM. 429, 429X. CHILD DEVELOPMENT (3) *Professor Avery*
CH. FAM. 430. OBSERVATION AND EXPERIENCE IN NURSERY SCHOOL (1-5)

Ch. Fam. 440, 440X. Study of Later Childhood (3) *Professor Avery*
Ch. Fam. 441. Nursery School Organization (3)
Ch. Fam. 481. Educational Methods with Preschool Children (3)
Ch. Fam. 482. Educational Procedures in Child Development and Family Relations (3) *Professor Morgan*
Ch. Fam. 495S. Family Health and Human Relations (3-9)

CIVIL ENGINEERING

Professor Benjamin A. Whisler, M.S., Sc.D.
Head of the Department

C.E. 500. Seminar in Civil Engineering (1-6) Reports on researches and special topics. Course may be continued in subsequent semesters.

C.E. 521. Transport Planning and Design (2-6) Planning and design of transportation facilities; basic principles and engineering techniques applied to airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

C.E. 522. Transport Operation and Maintenance (2-6) Engineering problems in the operation, maintenance, and administration of airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

C.E. 540. Advanced Structural Analysis (2-4) Geometry of flexure; deflections; analysis of continuous beams, rigid frames, arches; influence lines. Prerequisite: C.E. 40.

C.E. 541. Advanced Structural Analysis (2-4) Truss deflection; trusses with redundant members, continuous trusses, framed arches; influence lines; secondary stresses; wind stresses; space framework; suspension bridges. Prerequisite: C.E. 40.

C.E. 542. Applied Soil Mechanics (2-5) Soil classification by type of clay minerals and profile development; aerial photographic interpretation of soils and applications to site selection for dams, highways, and airports. Prerequisites: C.E. 412, 444, Geol. 71.

C.E. 543. Structural Engineering Projects (3-10) Investigation or design projects in concrete, soil mechanics, photoelasticity, analysis, etc. Prerequisite or concurrent: C.E. 441, 442.

C.E. 544. Advanced Structural Design (2-4) Plain and reinforced concrete design as applied to buildings, bridges, retaining walls, domes, tanks, and dams; prestressed concrete. Prerequisites: C.E. 42, 442.

C.E. 545. Advanced Structural Design (2-4) Structural steel design as applied to riveted and welded girders, trusses, rigid frames, wind connections; timber design. Prerequisite: C.E. 41.

C.E. 546. Structural Data as Basis for Design Specifications (2) Critical study of experimental data and design specifications for steel and reinforced concrete. Prerequisites: C.E. 41, 42.

C.E. 550. Engineering Construction (2-4) Construction methods applied to foundations, buildings, bridges, and other civil engineering construction work. Prerequisites: C.E. 41, 42.

C.E. 551. Hydrologic Investigations (2-8) Application of hydrologic principles and techniques to a specific project. Prerequisite: C.E. 451.

C.E. 560. Hydraulic Structures (3) Hydraulic and structural considerations in the design of dams, spillways, gates, canals and flumes, siphons, and locks. Prerequisite: C.E. 462.

C.E. 562. Advanced Fluid Mechanics (3) Euler's equations, potential theory, flow nets, conformal mapping, boundary layers, turbulence, compressibility, wave theory, flow of viscous fluids.

C.E. 563. Hydraulics Research (2-8) Analytical or experimental study of a problem in hydraulics. Prerequisite: C.E. 462.

C.E. 564. Hydraulic Engineering Design (2-8) Design and analysis of selected units of a typical hydraulic engineering project. Prerequisite: C.E. 462.

C.E. 566. Fluid Mechanics of Hydraulic Machinery (3) Advanced theory and design of hydraulic machinery. Prerequisite: C.E. 466.

C.E. 567. Resistance and Propulsion (3) Free surface and shallow water effects, planing surfaces, model testing, propellor systems, effects of wake and cavitation on propellors. Prerequisite: C.E. 562.

C.E. 568. Theoretical Hydrodynamics (3) Analysis of the irrotational motion of fluids in two and three dimensions, vortex motion, wave theory, theory of viscous fluids. Prerequisite: C.E. 562.

C.E. 569. Research in Fluid Dynamics (1-8) Analytical or experimental study of a problem in fluid dynamics. Prerequisite: C.E. 562.

C.E. 570. Rural Sanitation Design (3) Requirements and devices essential to rural sanitary problems: water supply, excreta disposal, industrial waste treatment. Not intended for civil or sanitary engineering students. Prerequisites: Chem. 4, Phys. 285.

C.E. 571. Water Purification and Softening (3) Current methods of softening, disinfecting, and conditioning water for municipal and industrial use. Prerequisite: C.E. 70.

C.E. 572. Sewage Treatment (3) Modern methods of sewage treatment. Prerequisite: C.E. 70.

C.E. 573. Advanced Problems in Sanitary Engineering (3-10) Continuation of C.E. 474 on a graduate level. Prerequisite: C.E. 474.

C.E. 575. Advanced Industrial Waste Treatment (3) Techniques of industrial waste treatment; attendant stream pollution and stream self-purification factors. Prerequisite: C.E. 472 or 572.

C.E. 576. Water Treatment Plant Design (1-6) Design of works for treatment of water for municipal and industrial use. Prerequisite: C.E. 71.

C.E. 577. Sewage Treatment Plant Design (1-6) Design of works for treatment of sewage or industrial wastes. Prerequisite: C.E. 71.

C.E. 578. Industrial Hygiene (3) Principles of control of industrial toxics and the protection of the worker and the community.

C.E. 579. Public Health Administration (3) Operation and duties of health departments at the various levels.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

C.E. 401a,b,c,d. Civil Engineering Projects (2-12)
C.E. 412. Advanced Photogrammetry (3)
C.E. 421. Highways and Streets (3)
C.E. 422. Railroads (3)
C.E. 423. Highway Safety and Traffic Control (3)
C.E. 431. Civil Engineering Construction (3)
C.E. 441. Statically Indeterminate Structures (3)
C.E. 442, 442X. Statically Indeterminate Structures (3)
C.E. 443. Photoelasticity and Model Analysis (3)
C.E. 444, 444X. Soil Mechanics and Foundations (3)
C.E. 446. Advanced Soil Mechanics (3)
C.E. 451. Advanced Hydrology (3)
C.E. 462. Advanced Hydraulics (3)
C.E. 463. Hydraulic Laboratory Investigations (1-6)
C.E. 465. Applied Hydraulics (3)
C.E. 466. Hydraulic Machinery (3)
C.E. 471. Municipal and Rural Sanitation (3)
C.E. 472. Sewage and Industrial Wastes Treatment (3)
C.E. 473. Water and Sewage Analysis (3)
C.E. 474. Sanitary Engineering Problems (1-6)
C.E. 475. Water Treatment and Conditioning (3)
C.E. 481. Municipal Planning and Zoning (3)
C.E. 482. Municipal Engineering and Management (3)

CLOTHING AND TEXTILES

Professor Ruth E. Graham, M.S.
Head of the Department

Cl. Tex. 500. Research in Clothing or Textiles (1-6 per semester)

Cl. Tex. 501. Thesis (1-15)

Cl. Tex. 502. Tailoring (3) The construction of tailored garments for women and children from new or renovated materials. Prerequisites: Cl. Tex. 102, 201.
Professor Westgate

Cl. Tex. 503. Advanced Fitting and Pattern Study (3) Application of the principles involved in altering patterns and fitting garments to give students freedom in designing and ability to deal with difficult fitting problems. Prerequisite: Cl. Tex. 201. *Professor Westgate*

Cl. Tex. 504. Advanced Dress Design (3) Draping of garments difficult in type and distinctive in design; survey of literature in dress design. Prerequisites: Art 56, Cl. Tex. 404.

Cl. Tex. 505, 505X. Clothing Instructional Materials (3) Preparation and evaluation of different types of materials for instruction in textiles and clothing. Prerequisite: Cl. Tex. 201.

Cl. Tex. 506. The Fashion World (3) The development of fashion throughout the ages; relationship of present-day fashions and practices to previous periods. Prerequisites: Cl. Tex. 102, 301. *Professor Graham*

Cl. Tex. 507. Problems in Relation to Clothing Consumption (3) Problems connected with the manufacture and consumption of clothing, interrelation of the textile and clothing trades with other industries. Prerequisite: Cl. Tex. 301.
Professor Graham

Cl. Tex. 508. Special Problems in Clothing and Textiles (1-6) Individual directed study, investigation, and practice in selected phases of textiles and clothing. Prerequisites: Cl. Tex. 102, 201.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Cl. Tex. 401. Clothing Conservation (2-3)
Cl. Tex. 403. Fitting and Pattern Adjustment (3) *Professor Westgate*
Cl. Tex. 404. Dress Design (3)
Cl. Tex. 405S. Fashion Merchandising (3)
Cl. Tex. 406. Fashion Promotion of Textiles and Clothing (3)
Cl. Tex. 407. The Textile and Clothing Industry (3)
Cl. Tex. 408. Textiles (3)

COMMERCE

Professor William N. Leonard, A.M., Ph.D.
Head of the Department of Economics and Commerce

Com. 500. Case Studies in Business Administration (3) Case studies of business and management policy with respect to procurement, production, selling, finance,

accounting, relations with government, labor, and the public. Prerequisite: Com. 401. *Professor Waters*

COM. 501. COMMERCE SEMINAR (3-6) Reports on research in selected fields of commercial activities.

COM. 505. PROBLEMS OF CORPORATION FINANCE (3) The more important current problems of corporate financial policy, particularly problems of promotion, capitalization, security issue, valuation, administration of income, expansion, reorganization, and government control of policy. Prerequisites: Com. 5, 41. *Professor Leffler*

COM. 510. INTERBANK RELATIONS (3) Local clearings, out-of-town collections, correspondent banking, branch and group banking, Federal Reserve relations with member and nonmember banks. Prerequisite: Com. 410. *Professor McKinley*

COM. 515. TRANSPORTATION RATES AND BUSINESS (3) Rate making and rate changes and their effects on business location and development. Prerequisite: Com. 15. *Professor Waters*

COM. 517. INTERNATIONAL BUSINESS PRACTICES (3) Practices of exporters and importers dealing in commodities traded in world markets under competition, monopoly, or governmental control. Prerequisite: Com. 17. *Professor Hench*

COM. 523. SEMINAR IN MARKETING (3) Research in modern marketing trends. *Professor Hilgert*

COM. 524. MARKETING POLICIES (3) Major problems of sales planning, organization, control, and supervision; current trends in merchandising policies of manufacturers; selection and training of salesmen, preparation of selling methods, sales budgets and sales quotas. Prerequisite: Com. 424. *Professor Hilgert*

COM. 525. CASE STUDIES IN INSURANCE (3) An analysis of management's insurance problems, such as the feasibility of self-insurance; proper allocation of insurance premiums and coverage in selected industries, etc. Prerequisites: Com. 25; 33 or 34. *Professor Wherry*

COM. 526. PROBLEMS OF ADVERTISING (3) Advertising budgeting, selection of media, appraisal of effectiveness, co-ordination of advertising and selling efforts. Prerequisite: Com. 23. *Professor Hilgert*

COM. 536. PROBLEMS IN SALES MANAGEMENT (3) Principles of sales planning and administration; co-ordination of selling with advertising, promotion, production, and accounting; use of market research selling costs and budgets. Prerequisites: Com. 36, Econ. 1. *Professor Hilgert*

COM. 540. ACCOUNTING SEMINAR (3) Selected phases of accounting theory. Prerequisite: Com. 43. *Professor Rowland*

COM. 548. ACCOUNTING SYSTEMS (3) Principles of system design including practical application to special businesses, such as financial institutions, department stores, public utilities, etc. Prerequisite: Com. 442. *Professor Rowland*

COM. 550. REAL ESTATE PROBLEMS (3) Analysis of current real estate problems and practices for the broker, the business man, and the property owner; appraisal methods; property management; housing, and the legal, financial, economic, and social aspects of the real estate field. Prerequisite: Com. 50.

COM. 560. CASE STUDIES IN AMERICAN INDUSTRIES (3) The economic relationship of such factors as climate, resources, population, transportation and markets, and the location of enterprise. Prerequisite: Com. 60. *Professor Mares*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

COM. 401.	PURCHASING (3)	*Professor Babione*
COM. 402.	CONTROLLERSHIP (3)	*Professor Nelson*
COM. 405.	ANALYSIS OF FINANCIAL STATEMENTS (3)	*Professor Cook*
COM. 410.	BANK MANAGEMENT (3)	*Professor McKinley*
COM. 415.	REGULATION OF TRANSPORT CARRIERS (3)	*Professor Waters*
COM. 417.	FOREIGN MARKETS (3)	*Professor Hench*
COM. 423.	ADVERTISING PROCEDURE (3)	*Professor Hilgert*
COM. 424.	MARKETING RESEARCH (3)	*Professor Hilgert*
COM. 425.	INSURANCE AGENCY MANAGEMENT (3)	*Professor Wherry*
COM. 428.	RETAIL ADVERTISING AND STORE PROMOTION (3)	*Professor Babione*
COM. 430.	ADVANCED BUSINESS LAW (3)	*Professor Tanner*
COM. 431.	C.P.A. LAW REVIEW (3)	*Professor Tanner*
COM. 436.	FUNDAMENTALS OF SALES MANAGEMENT (3)	*Professor Hilgert*
COM. 442.	ADVANCED ACCOUNTING (3)	*Professor Lordeman*
COM. 444.	BUDGETARY CONTROL (3)	*Professor Nelson*
COM. 448.	C.P.A. REVIEW COURSE (3)	*Professor Rowland*
COM. 460.	AMERICAN INDUSTRIES (3)	*Professor Mares*
COM. 470.	PUBLIC RELATIONS IN BUSINESS (3)	*Professor Wherry*

COMMERCIAL CONSUMER SERVICES

PROFESSOR MARY BROWN ALLGOOD, M.S.
Chairman of the Division

The following courses may be taken for graduate credit under the restrictions in force:

C. CON. S. 403.	LECTURE-DEMONSTRATION TECHNIQUES (3)	*Professor Allgood*
C. CON. S. 450.	PROBLEMS IN HOUSEHOLD EQUIPMENT (1-6)	*Professor Allgood*

DAIRY HUSBANDRY

PROFESSOR DONALD V. JOSEPHSON, M.S., Ph.D.
Head of the Department

D.H. 501. BUTTER AND CHEESE (1-6) The manufacture and handling of butter and cheese. Prerequisites: D.H. 10, 23, Bact. 8, Agr. Biochem. 403.
Professor Dahle

D.H. 502. CONDENSED MILK AND MILK POWDER (1-6) The condensing and drying of milk. Prerequisites: D.H. 10, 26, Bact. 8, Agr. Biochem. 403. *Professor Doan*

D.H. 503. PUBLIC MILK PROBLEMS (1-6) The handling of milk in modern plants. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403. *Professor Doan*

D.H. 504. ICE CREAM MANUFACTURE (1-6) The manufacture of ice cream, ices, and other frozen milk products. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403. *Professor Dahle*

D.H. 505. DAIRY PLANT ECONOMICS (1-6) The economic factors involved in creamery operation and management. Prerequisites: D.H. 7, 11. *Professor Dahle*

D.H. 506. DAIRY CATTLE BREEDING (1-6) The improvement of dairy cattle, including methods of sire evaluation, systems of breeding, and the development of breeding programs. Prerequisite: D.H. 30. *Professor Almquist*

D.H. 507. DAIRY CATTLE MANAGEMENT (1-6) The management of dairy cattle. Prerequisite: D.H. 27. *Professor Williams and Staff*

D.H. 508. DAIRY SEMINAR (1-6) The preparation and presentation of a paper on an assigned subject. *Professor Josephson and Staff*

D.H. 509. TESTING DAIRY PRODUCTS (1-6) The constituents of dairy products. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403. *Professor Swope*

D.H. 510. DAIRY CATTLE FEEDING (1-6) The application of fundamental research in animal nutrition to the feeding of dairy cattle. Prerequisites: D.H. 1, 29.
Professor Williams

D.H. 511. DAIRY CATTLE NUTRITION (1-6) The nutritional requirements of dairy cattle. Prerequisites: An. Nutr. 401, 402. *Professor Knodt and Staff*

D.H. 512. ADVANCED STUDIES IN MILK SECRETION (1-6) The physiology of milk secretion. Prerequisite: D.H. 427. *Professor Knodt*

D.H. 513. DAIRY CATTLE SELECTION (1-6) Breed history, pedigrees, selection and judging of dairy cattle. Prerequisites: D.H. 1, 30. *Professor Knodt and Staff*

D.H. 514. ADVANCED REPRODUCTIVE AND ENDOCRINE PHYSIOLOGY (2-3) The physiology of reproduction and endocrine physiology of mammals. Prerequisites: A.H. 415, D.H. 431. Given in alternate years. *Professor Almquist*

D.H. 515. Advanced Physiology of Reproduction in Farm Animals (1-6) The reproduction of farm animals. Prerequisite: D.H. 514. *Professor Almquist*

D.H. 516. Artificial Breeding of Farm Animals (1-6) Prerequisite: D.H. 431. *Professor Almquist*

D.H. 517. Dairy Husbandry Literature (1-6) The review and reporting of dairy literature. *Professor Josephson and Staff*

D.H. 518. Thesis (1-15) *Professor Josephson and Staff*

D.H. 519. Research in Dairy Production (1-15 per semester) *Professor Josephson and Staff*

D.H. 520. Research in Dairy Manufacturing (1-15 per semester) *Professor Josephson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

D.H. 418. Dairy Survey (1) *Professor Josephson*
D.H. 421. Dairy Manufacturing Problems (1-6) *Professors Dahle, Doan, and Staff*
D.H. 427. Milk Secretion (3) *Professor Knodt*
D.H. 428. Dairy Production Problems (1-3) *Mr. Dawdy and Staff*
D.H. 429. Testing Dairy Products (1-6) *Professor Swope and Staff*
D.H. 430. Technical Control of Dairy Products (4) *Mr. Watrous*
D.H. 431. Physiology of Reproduction in Farm Animals (3) *Professor Almquist*

DRAMATICS

Consult Professor Arthur C. Cloetingh, M.A.

Dram. 501. Problems of Directing (3-6) Seminar in problems of production with particular stress on direction. Students will direct plays under staff supervision.

Dram. 502. Seminar in the Technical Problems of Dramatic Production (3) Prerequisite: Dram. 11.

Dram. 503. Art of Dramatic Lighting (3) Seminar in stage lighting; advanced study in the theory of lighting as used for dramatic effectiveness. Practical work required of each student. Prerequisite: Dram. 12.

Dram. 504. Seminar in Styles of Acting (3-6) Practical work required of each student.

Dram. 506. Evaluation and Appreciation of Modern Dramatic Entertainment (3) Prerequisites: Dram. 1, 61.

DRAM. 507. SEMINAR IN FUNDAMENTAL THEORIES OF THEATER AND DRAMA (3-6) Prerequisite: graduate standing.

DRAM. 521. PLAYWRITING (3-6) Prerequisites: Dram. 21, 421.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

DRAM. 403. ADVANCED MAKE-UP (1)
DRAM. 411. TECHNICAL PRODUCTION (3)
DRAM. 412. DRAMATIC DESIGN (3)
DRAM. 413. ADVANCED STAGE LIGHTING (3)
DRAM. 421. ADVANCED PLAYWRITING (3)
DRAM. 431. HISTORY OF THE THEATRE (3)
DRAM. 441. EDUCATIONAL DRAMATICS (CHILDREN'S ENTERTAINMENT) (3)
DRAM. 442S. EDUCATIONAL DRAMATICS (3)
DRAM. 443S. EDUCATIONAL DRAMATICS (ADVANCED MARIONETTES) (3)
DRAM. 451. DIRECTING (3)
DRAM. 470. DRAMATICS IN THE SCHOOLS (3)
DRAM. 480. RADIO DRAMA (3)
DRAM. 481. ADVANCED RADIO DRAMA (3)

ECONOMICS

PROFESSOR WILLIAM N. LEONARD, A.M., Ph.D.
Head of the Department of Economics and Commerce

ECON. 500. ECONOMICS SEMINAR (3-6)

ECON. 501. RESEARCH METHODS IN ECONOMICS (3-6) *Professor Waters*

ECON. 502. VALUATION OF PUBLIC UTILITIES (3) *Professor Cook*

ECON. 503. PRICES AND PROFITS (3) *Professor Cochrane*

ECON. 504. PROBLEMS OF CORPORATION FINANCE (3) *Professor Leffler*

ECON. 505. TRANSPORTATION SEMINAR (3) Prerequisite: Com. 15. *Professor Waters*

ECON. 507. INTERNATIONAL ECONOMIC RELATIONS (3) *Professor Hench*

ECON. 508. BANKING PROBLEMS (3) Prerequisite: Econ. 51. *Professor McKinley*

ECON. 509. TAXATION PROBLEMS (3) *Professor Stout*

ECON. 510. DEMAND ANALYSIS (3)

ECON. 511. ECONOMIC BASES FOR CONTROL OF INDUSTRIAL DISPUTES (3) Prerequisites: Econ. 1 or 14; 15. *Professor Myers*

ECON. 512. WAGES (3) *Professor Brown*

ECON. 515. LABOR SEMINAR (3) *Professor Reede*

ECON. 520. ADVANCED ECONOMIC STATISTICS (3) Prerequisites: 6 credits in economics and 3 in statistics. *Professor Saylor*

ECON. 522. ADVANCED ECONOMIC THEORY (3) The theory of price and the allocation of scarce resources in the production of goods and services demanded. Prerequisites: Econ. 2, 405. *Professor Cochrane*

ECON. 523. ADVANCED ECONOMIC THEORY (3) The theory of income determination (National Income) as a method of explaining variations in "output as a whole." Prerequisite: Econ. 522. *Professor Cochrane*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ECON. 400. HISTORY OF ECONOMIC THOUGHT (3) *Professor Senn*
ECON. 401. RECENT ECONOMIC THOUGHT (3) *Professor Senn*
ECON. 405. INTERMEDIATE ECONOMIC THEORY (3) *Professor Leonard*
ECON. 409. THEORY OF INTERNATIONAL TRADE (3) *Professor Reedy*
ECON. 410. ECONOMICS OF CONSUMPTION (3) *Professor Keyes*
ECON. 411. ECONOMICS OF LABOR RELATIONS (3) *Professor Myers*
ECON. 412. ECONOMICS OF COLLECTIVE BARGAINING (3) *Professor Luchek*
ECON. 414. ECONOMICS OF LABOR LEGISLATION (3) *Professor Myers*
ECON. 415. SOCIAL INSURANCE (3) *Professor Reede*
ECON. 416. MANAGEMENT OF LABOR RELATIONS (3) *Professor Brown*
ECON. 417. INTERNATIONAL COMMERCIAL POLICIES (3) *Professor Reedy*
ECON. 418. ECONOMICS OF WAGES AND EMPLOYMENT (3) *Professor Brown*
ECON. 419. CASE STUDIES IN LABOR-MANAGEMENT RELATIONS (3) *Professor Reede*
ECON. 420. INVESTMENTS (3) *Professor Malott*
ECON. 421. CENTRAL AND INTERNATIONAL BANKS (3) *Professor McKinley*
ECON. 422. INVESTMENT BANKING (3) *Professor Bradley*
ECON. 423. PENNSYLVANIA LOCAL FINANCE (3) *Professor Stout*
ECON. 424. PENNSYLVANIA STATE FINANCE (3) *Professor Stout*
ECON. 425. THE MONEY MARKET (3) *Professor McKinley*
ECON. 426. FISCAL POLICY (3)
ECON. 430. NATIONAL PLANNING (3) *Professor Keyes*
ECON. 431. HOUSING AND COMMUNITY DEVELOPMENT (3) *Professor Keyes*
ECON. 433. FOREIGN EXCHANGE (3) *Professor Reedy*
ECON. 435. PROBLEMS OF FEDERAL FINANCE (3) *Professor Stout*
ECON. 450. THE BUSINESS CYCLE (3) *Professor Leonard*
ECON. 460. LOCATION OF ECONOMIC ENTERPRISE (3) *Professor Mares*
ECON. 490. MEASUREMENT OF THE ECONOMY (3) *Professor Saylor*
ECON. 491. ADVANCED BUSINESS STATISTICS (3) *Professor Saylor*
ECON. 492. DEMOGRAPHIC STATISTICS (3) *Professor Saylor*
ECON. 499X. FOREIGN STUDY IN ECONOMICS (2-6)

EDUCATION

Professor Charles M. Long, M.A., D.Ed.
Head of the Department

Ed. 501. Introduction to the Advanced Study of Education (1-3) Methods of educational research; criticism of studies and theses in education; initiating research projects; summarizing the results of research. Prerequisite: Ed. 470 or Psy. 415.

Ed. 502. Techniques in Educational and Vocational Guidance (3) Principles, techniques, and practical experience in guidance cases; designed as preparation for public school counselors and directors of guidance.

Ed. 515. Comparative European Education (3) Educational policies and practices in school systems in western and central European nations. Prerequisite: Psy. 14. *Professor Champlin*

Ed. 516. Social Foundations of the Curriculum (2-4) Analysis of societal needs as a basis for educational programs; contributions of public education to social advancement. Prerequisites: Ed. 25, Psy. 14. *Professor McNerney*

Ed. 517. Evolution of Educational Thought (2-3) Rise of formal educational philosophy from Plato to John Dewey; preliminary reference to Chinese, Hindu, Chaldean, Persian, Hebrew, and Egyptian theories. Prerequisite: graduate maturity. *Professor Champlin*

Ed. 522. Production of Educational Moving Pictures (1-3) Nonlaboratory course on production techniques from the sponsor's viewpoint; script writing; photography, editing, sound recording. Prerequisites: Ed. 424, 487 (Unit B). Conference 1 hour, alternate weeks by appointment. *Professor VanderMeer*

Ed. 523. Laboratory in Organizational Aspects of Materials of Instruction (1-3) Organizing, storing, circulating, and maintaining instructional materials in an instructional materials library. Prerequisites: Ed. 424, 585. Conference 1 hour, alternate weeks by appointment. *Professor VanderMeer*

Ed. 524. Seminar in Curriculum Materials and Their Utilization (3) Advanced detailed analysis of mass communication media; relationships among these and educational objectives, individual differences in learners, and ideas to be communicated. Prerequisites: Ed. 424, 585, 6 hours of educational psychology. *Professor VanderMeer*

Ed. 525. Modern Tendencies in Educational Method (2-3) Study of science supporting dynamic instruction; principles of teaching as guides; analysis of modern procedures; understanding of learning; substance versus plans. Prerequisite: 12 semester hours of undergraduate work in education. *Professor Butler*

Ed. 527. Problems in the Education of the Mentally Retarded (1-4) Study of existing curricula, instructional practices, educational programs; experimenta-

tion in curriculum building and materials construction. Prerequisites: Ed. 426 or 583, Unit P, and Ed. 427 and teaching experience.

Ed. 529. Problems in the Education of the Mentally Gifted (1-4) Analysis of educational needs of mentally gifted; curriculum construction and curricular materials. Prerequisites: teaching experience and Ed. 426 or 583, Unit P, and 429.

Ed. 532. Suervision of Student Teachers (3) A course in supervision for master teachers, department heads, and college teachers with supervisory responsibilities in teacher education. Prerequisite: experience in teaching and 18 credits in education, including at least 5 in methods. *Professor Taylor*

Ed. 534a. Reading Clinic Practice: Analysis of Reading Disabilities (1-9) A laboratory course consisting of analysis of extreme reading disabilities and recommended remedial procedures; experience in preparation of case reports. Prerequisite: Ed. 432g or Psy. 550.

Ed. 534b. Reading Clinic Practice: Remedial Procedures (1-9) Practicum in special classes for reading disabilities; corrective and remedial procedures; specific procedures for correction of various types of reading disabilities. Prerequisite: Ed. 432g or 534a.

Ed. 535. Seminar on Reading Instruction (2-12) Designed to appraise significant researches and to outline procedures and materials for research; reading readiness, word perception, basic reading skills, vocabulary development. Prerequisite: Ed. 432b or 432c.

Ed. 536. Reading Clinic Research (1-15) Prerequisites: Ed. 432b; or Ed. 432c, 432g.

Ed. 540. Problems of Elementary Education (2-3) A problems seminar for experienced educators. Prerequisite: 12 credits in education and psychology, including 6 credits in elementary education. *Professor Bixby*

Ed. 541. Seminar in Contemporary Issues in Elementary Education (1-3) Conferences and discussions designed to meet the needs of experienced teachers and principals in the field of elementary education. Prerequisite: 6 credits in elementary education and teaching experience.

Ed. 546. Elementary School Principal as Supervisor (2-3) *Professor Bixby*

Ed. 548. Organization of the Elementary School Curriculum (2-3) Principles underlying curriculum construction. Primarily for elementary education majors. Prerequisite: Ed. 31 or teaching experience. *Professor Bixby*

Ed. 550. Problems in Modern Secondary Education (1-4) Historical, psychological, social, and economic factors influencing secondary education; required as basic course of all graduate students in secondary education. Prerequisite: Ed. 450 or secondary school teaching. *Professor Butler*

ED. 551. SEMINAR IN CONTEMPORARY ISSUES IN SECONDARY EDUCATION (2-9)

Unit A. The Secondary School Curriculum (2-3) Principles and philosophy of curriculum construction. Each student works out an individual problem in the secondary school curriculum. Prerequisites: 12 credits in education and psychology, and teaching experience. *Professor Moyer*

Unit B. Laboratory Studies in Application of Educational Method (2-3) Analysis and application of outstanding studies in secondary education; integration of results of educational research with public school procedures. Prerequisites: 12 credits in education and psychology, and teaching experience.

Unit C. Organization and Administration of Secondary Education (2-3) Problems in the reorganization of secondary education, with particular reference to philosophy, organization, and teaching problems of the junior high school. Prerequisites: 12 credits in education and psychology, and teaching experience.

ED. 556. THE SECONDARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3) Improvement of instruction; improvement of teachers in service; evaluation of teaching procedures; methods of supervision; selection and use of textbooks. Prerequisite: three years' teaching experience. *Professor Wyland*

ED. 561. THE COMMUNITY COLLEGE AND POST-SECONDARY SCHOOL EDUCATION (2-3) The philosophy, organization, and character of school programs needed to meet the educational needs of individuals who desire to continue their education on the post-secondary school level. Prerequisites: Ed. 450, 480, 550; Psy. 414 or educational experience. *Professor Weaver*

ED. 562. THE INSTRUCTIONAL PROGRAM IN COMMUNITY COLLEGES AND POST-SECONDARY EDUCATION (2-3) Course offerings, curricula, instructional materials and procedures, guidance, extracurricular activities, student personnel, evaluation of results, and faculty qualifications. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience. *Professor Weaver*

ED. 563. THE PROFESSIONAL EDUCATION OF TEACHERS (3) Development and present status of teacher education; objectives and standards; selection and guidance of students; personnel problems in relation to staff. Prerequisite: 6 credits in advanced courses in education and a course in educational psychology.

ED. 564. RECENT TRENDS IN HIGHER EDUCATION (2-3) Factors affecting current college enrollment, organization, administration, support, and curricula, with special emphasis on general education, its development, aims, and forms.

ED. 565. THE PRINCIPLES OF COLLEGE TEACHING (2-3) Principles involved in teaching at the college level; effective use of teaching aids; criteria used in evaluation.

ED. 566. STUDENT PERSONNEL PROGRAMS AT THE COLLEGE LEVEL (2-3) Student personnel services in higher education; organization of student advisory programs; use of personnel data; co-curricular activities; student welfare.

Ed. 567. Growth and Organization of Higher Education (2-3) Growth of higher education; influence of church, state, federal government; educational, social, and economic factors that have affected curricula and organization of institutions. *Professor Weaver*

Ed. 568. Curricula in Higher Education (2-3) Various types of curricula and philosophies underlying them; ways in which curricula are developed; elective versus required courses; evaluation of achievement. *Professor Weaver*

Ed. 569. Seminar in Collegiate Education (1-6) Special topics in higher education. Prerequisite: Ed. 567. *Professor Weaver*

Ed. 574. Advanced Educational Statistics (2-4) Appropriate measures and devices for experimental research in education including correlation measures, curve fitting, and the analysis of variance. Prerequisite: 12 credits of graduate work in education including Ed. 470 or Psy. 415.

Ed. 575. Administration and Supervision in Business Education (3) Work of administrators, supervisors, and others responsible for improvement of instruction in business education; use of vocational testing; job analysis. Prerequisite: 6 credits in secondary education. *Professor Gemmell*

Ed. 576. Introduction to Research in Business Education (3) Methods of research in business education; opportunity to compile annotated bibliographies on current problems; analysis and evaluation of significant research. *Professor Gemmell*

Ed. 577. Evaluation of Research and Empirical Literature in Business Education (3) Application of evaluation methods to current literature in business education; special attention to research studies. Prerequisite: Ed. 576. *Professor Gemmell*

Ed. 578. Seminar in Business Education (3) Intended for graduate students preparing theses or final documents, or for those working on special studies in business education. Prerequisite: Ed. 577. *Professor Gemmell*

Ed. 580. Seminar in School Administration (1-6) Efficiency in supervision, methods of diagnosis and evaluation of teaching and learning procedure, improving instruction, maintaining teacher morale, stimulating co-operative work. Prerequisites: Ed. 480, 6 credits of Ed. 583.

Ed. 582. Educational Survey Techniques (2-3) Methods for the appraisal of an educational program; planning for expansion, consolidation, or reduction of educational offerings. Prerequisites: Ed. 480 and 6 credits of Ed. 583.

Ed. 583. Problems in Administration and Supervision (2-21) Prerequisite: Ed. 480 or teaching or administrative or supervisory experience.
Unit A. The Educational Plant (2)
Unit B. Public Relations for School Administrators (2-3)
Unit C. Public School Finance (2-3)
Unit I. Administration of Adult Education in the Public Schools (3)

Unit M. Legal Aspects of School Administration (3)
Unit P. The Administration of Public School Education for Atypical Children (2)
Unit Q. Dynamic Factors in School Administration (2)
Unit R. Public School Business Administration (2-3)

Ed. 585. Curriculum Construction (2-3) Functions of administrators, supervisors, teachers, pupils, laymen in curriculum building to meet pupil and community needs.

Ed. 586. Principles of School Supervision (2-3) Organization of supervision; planning the supervisory program; developing standards of teaching and learning; improvement of learning through tests and teacher rating. Prerequisites: 18 credits in education and 3 years' teaching experience.

Ed. 587. The Secondary School Principal as Administrator (2-4) Problems of schedule making, teachers' meetings, curriculum making and revision, organization of extracurricular and guidance programs. Prerequisite: teaching experience.
Professor Wyland

Ed. 589. The Elementary School Principal as Administrator (2-3) The duties of the elementary school principal in organizing and administering his school. Prerequisite: Ed. 442. *Professor Bixby*

Ed. 590. The Philosophy of Education (2-4) Fundamental principles; scientific sanctions of progressive instructional practices and professional experiences as bases for formulation of the educational creed. Prerequisite: 18 credits in education. *Professor Champlin*

Ed. 591. Education in Russia, Asia, and the Middle East (2-3) Current educational activities in Soviet Russia and other eastern European countries; the Middle East, North Africa, and the Far East.

Ed. 592. Education in the Latin-American Countries (2-3) Recent educational progress in Central and South America, with special reference to Mexico, Cuba, Puerto Rico, Brazil, Chile, and Argentina.

Ed. 594. Seminar in Education (1-6) Conferences and discussions designed to meet the need for special study of particular fields in education. Prerequisite: requirements for graduation in education.

Ed. 595. Educational Research (1-15) An inductive research from primary sources expected to maintain standards sufficiently high to warrant publication of the findings. Prerequisite: at least 6 hours of graduate study in education, including some work in statistics.

Ed. 597S. Workshop in Current Educational Problems (1-6) For administrators, supervisors, experienced elementary and secondary teachers, guidance workers; administrative, supervisory, and instructional problems involved in an emerging educational program. Prerequisite: 12 credits of graduate work in education.
Professor Wyland

ED. 599. THESIS (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ED. 412, 412X. HISTORY OF MODERN EUROPEAN EDUCATION (3) *Professor Champlin*
ED. 413, 413X. HISTORY OF EDUCATION IN THE UNITED STATES (2-3) *Professor Champlin*
ED. 414. HISTORY OF EDUCATION IN PENNYLVANIA (2-3) *Professor Champlin*
ED. 415S, 415X. MODERN TENDENCIES IN AMERICAN EDUCATION (1-6)
ED. 416X. SOCIAL EDUCATION (3)
ED. 421X. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3)
ED. 424, 424X. VISUAL AND OTHER SENSORY AIDS FOR TEACHERS (1-3) *Professor VanderMeer*
ED. 425S, 425X. THE SCIENTIFIC DIRECTION OF LEARNING ACTIVITIES (2-4)
ED. 426, 426X. EDUCATION OF EXCEPTIONAL CHILDREN (2-3) *Professor Neuber*
ED. 427. EDUCATION OF THE MENTALLY RETARDED (2-3) *Professor Neuber*
ED. 428, 428X. UNITS A, B, C. ADULT EDUCATION: ORGANIZATION, TYPES, AND METHODS (1-3) *Professor Champlin*
ED. 429, 429X. EDUCATION OF THE MENTALLY GIFTED CHILD (1-3) *Professor Neuber*
ED. 430, 430X. VISUAL AND OTHER AIDS IN SAFETY EDUCATION (3)
ED. 431, 431X. PRINCIPLES AND METHODS OF TEACHING SAFETY EDUCATION (3)
ED. 432b, 432bX. THE ELEMENTARY SCHOOL READING PROGRAM (2-3)
ED. 432c, 432cX. READING PROBLEMS IN THE SECONDARY SCHOOL (2-3)
ED. 432d, 432dX. SPECIAL PROBLEMS IN THE TEACHING OF ELEMENTARY SCHOOL ENGLISH (2-3)
ED. 432eX. CHORAL SPEAKING (3)
ED. 432f, 432fX. TEACHING SECONDARY SCHOOL ENGLISH (2-3)
ED. 432g, 432gX. READING DISABILITIES (2-3)
ED. 432h, 432hX. TECHNIQUES IN REMEDIAL READING (2-6)
ED. 433e. ADVANCED THEORY OF KINDERGARTEN (3)
ED. 433f, 433fX. TEACHING CHILDREN'S LITERATURE (2-3)
ED. 433h, 433hX. PROBLEMS OF ELEMENTARY SCHOOL ARITHMETIC (2-3) *Professor Neuber*
ED. 433n, 433nX. TEACHING SOCIAL STUDIES IN THE ELEMENTARY GRADES (2-3) *Professor Taylor*
ED. 433w, 433wX. TEACHING SOCIAL STUDIES IN THE HIGH SCHOOL (2-3) *Professor VanderMeer*
ED. 433y, 433yX. TEACHING MATHEMATICS IN THE SECONDARY SCHOOL (3)
ED. 435X. EDUCATION FOR CITIZENSHIP (2-3) *Professor Champlin*
ED. 438, 438X. TEACHING SCIENCE IN SECONDARY SCHOOLS (2-3) *Professor Free*
ED. 438e, 438eX. TEACHING SCIENCE IN THE ELEMENTARY SCHOOL (1-3) *Professor Free*
ED. 439, 439X. TEACHING TRAFFIC SAFETY AND AUTOMOBILE OPERATION (1-3) *Professor Neyhart, Mr. Intorre*
ED. 441X. PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS (2-3) *Professor Bixby*

Ed. 442, 442X. Elementary Education (2-3) *Professor Bixby*

Ed. 446. Diagnosis of Attainment (3)

Ed. 448X. Organization of the Elementary School Curriculum (2-3) *Professor Bixby*

Ed. 449aS. Teaching of Conservation of Natural Resources in the Elementary School (3) *Professor Free*

Ed. 449bS. Teaching of Conservation of Natural Resources in the Secondary School (3) *Professor Free*

Ed. 450X. Secondary Education (2-3) *Professor Butler*

Ed. 451X. Special Problems of the High School Teacher (2-3)

Ed. 453, 453X. Educational and Vocational Guidance (2-3) *Professor Wyland*

Ed. 454, 454X. Extracurricular Activities in the Junior and Senior High School (2-3) *Professor Moyer*

Ed. 456, 456X. Principles and Problems in Business Education (1-3) *Professor Gemmell*

Ed. 459, 459X. Improvement of Instruction in Business Skill Subjects (1-3) *Professor Gemmell*

Ed. 460. Curricula in Business Education (3) *Professor Gemmell*

Ed. 461. Improvement of Instruction in Basic Business Subjects (3) *Professor Gemmell*

Ed. 462. Teaching Shorthand and Typewriting (3) *Professor Gemmell*

Ed. 463. Bookkeeping for Teachers (3) *Professor Gemmell*

Ed. 466. Teaching of Office Practice (3) *Professor Gemmell*

Ed. 467. Teaching of Shorthand (2-3) *Professor Gemmell*

Ed. 468. Teaching of Typewriting (2-3) *Professor Gemmell*

*Ed. 470, 470X. Educational Measurements (2-3)

Ed. 474, 474X. Teaching of Occupations (2-3)

Ed. 480, 480X. Educational Administration (2-3)

Ed. 482X. Supervision and Improvement of Instruction (2-3)

Ed. 485X. Curriculum Construction (2-3)

Ed. 487, 487X. Problems in Visual and Other Sensory Aids in Education (1-12) Unit A (1-3), Unit B (1-2), Unit C (1-2), Unit D (1-2), Unit E (3) *Professor VanderMeer*

Ed. 490X. Philosophy of Education (3) *Professor Champlin*

Ed. 491X. School Law (3)

Ed. 493, 493X. Character Education and Guidance (2-3) *Professor Champlin*

Ed. 494. Religious Education (2-3)

Ed. 495S. Family Health and Human Relations (3-9)

Ed. 497S, 497X. Workshop in Selected Studies in the Field of Elementary and Secondary Education (1-6) *Professor Wyland and Staff*

Ed. 498, 498X. Practicum in the Education of Atypical Children (3-6) Unit A (3), Unit B (3), Unit C (3), Unit D (3), Unit E (3)

Ed. 499, 499X. Problems of Special Education (3) *Professor Neuber*

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* No credit if credit has been received for Ed. 70.

ELECTRICAL ENGINEERING

Professor Eric A. Walker, M.S., Sc.D.
Head of the Department

E.E. 520. Seminar (1) Required of all graduate students in electrical engineering. Conferences, reading, and presentation of technical papers.

E.E. 521a,b,c,d. Alternating-Current Theory (2-12) Special problems in alternating-current theory and the application of these problems to alternating-current circuits or machinery at any frequencies.

E.E. 522. Power Generation (3) Problems of the generating station in the electrical power system including economic and technical considerations of station location, operation, and control; selection and layout of equipment.
Professor Powell

E.E. 523. Transients in Linear Systems (3) Transient response of linear electric circuits and electromechanical systems including the application of operational methods of analysis to electrical and electromechanical problems. Prerequisite: E.E. 423. *Professor Holt*

E.E. 524. Engineering Electronics (3) Special problems dealing with the design and application of electronic devices and systems; emphasis upon individual projects closely related to other phases of the student's graduate program.
Professor Stavely

E.E. 525. Symmetrical Components (3) Polyphase circuits and machines under unbalanced conditions of operation including the effects of rotating machines upon the distribution and transmission system performance; characteristics of phase converters and single-phase operation of polyphase systems. Prerequisite: E.E. 425. *Professor Holt*

E.E. 526a,b. Electric Illumination (3-6) Problems in photometry; methods of evaluating illumination in terms of safety and seeing value; development of improved methods for illumination calculations.

E.E. 527. Electrical Design Engineering (3) Special problems in the design of alternating and direct-current apparatus.

E.E. 528. Servomechanisms (3) An advanced treatment of the transient and steady-state behavior of closed-cycle control systems with special attention to stability and the design of stabilizing controllers. Prerequisite: E.E. 428.
Professor Tarpley

E.E. 529a,b. Precision Measurements (3-6) Advanced measurements in electricty and magnetism, usually involving the development of laboratory techniques applicable to specific research problems; development of special measuring devices.

E.E. 530. Audio Frequency Engineering (3) Electrical systems and equipment

used in production, recording, amplification, transmission, and measurement of sound. Prerequisite: E.E. 11 or 13. *Professor Hall*

E.E. 531a,b,c. Radio Frequency Engineering (3-9) Radio frequency equipment, measurements, and systems; amplifiers, modulators, demodulators, transmitters, receivers, transmission lines, antennae, and radiators. Prerequisite: E.E. 431. *Professor Hall*

E.E. 532. Ultra-High-Frequency Engineering (4) Theory of transmission lines, wave guides, resonant cavities, antennae, and wave propagation. Prerequisite: E.E. 432. *Professor Hall*

E.E. 533. Automatic Control Systems (2-3) Automatic control, telemetering, and recording of electrical, mechanical, thermal, and chemical quantities. Prerequisite: E.E. 4. *Professor Rice*

E.E. 535. Engineering Analysis (3) The engineering applications of complex variables, conformal mapping methods and potential plotting, Laplace transform methods and stability criteria. Prerequisite: E.E. 435. *Professor Davids*

E.E. 538. Electromagnetic Engineering (3) Electrical and magnetic fields, using the Maxwell-Lorentz equations as applied to vector fields and special solutions for antennae, wave guides, and other engineering applications. Prerequisite: E.E. 438. *Professor Van Meter*

E.E. 550. Communication Networks (3) Methods of filter design using lattice networks; the effects of dissipation on the characteristics of filter networks; transient response of networks and the design of equalizers. Prerequisite: E.E. 450. *Professor Tarpley*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

E.E. 421a,b,c,d. Electrical Engineering Problems (2-12)

E.E. 423. Transient Phenomena (3) *Professor Holt*

E.E. 424. Engineering Electronics (3) *Professors Smith and Shields*

E.E. 425. Symmetrical Components (3) *Professor Holt*

E.E. 428. Servomechanisms (3) *Professor Tarpley*

E.E. 431. Vacuum-Tube Circuits (3) *Professor Van Meter*

E.E. 432. Ultra-High-Frequency Techniques (3) *Professor Hall*

E.E. 434. Industrial Electronics (3) *Professor Stavely*

E.E. 435. Engineering Analysis (3) *Professor Tarpley*

E.E. 438. Fundamentals of Electric Waves (3)

E.E. 450. Electrical Network Theory (3) *Professor Tarpley*

E.E. 460. High-Voltage Engineering (3) *Professor Armington*

ENGINEERING

Consult Dean H. P. Hammond, C.E., D.Eng., LL.D.

The following course may be taken for graduate credit under the restrictions in force:

Eng. 400. Production Engineering (3)

ENGINEERING EXPERIMENT STATION

Professor Maurice Nelles, A.M., Ph.D.
Director

Eng. Exp. Sta. 501. Fuel Injection and Combustion in Diesel Engines (2-6) Characteristics and efficiency of various injection systems. *Professor Stanley*

Eng. Exp. Sta. 502. Diesel Engine Research (3-15 per semester) An original investigation dealing with the design, construction, operation, or application of Diesel engines. *Professor Schweitzer*

Eng. Exp. Sta. 504. Fuel Spray Laboratory (3) A laboratory study of fuel injection for the Diesel engine. *Professor Stanley*

Eng. Exp. Sta. 505. Transient Elastic Phenomena (3) Analysis, by graphical methods, of transient phenomena in fluid flow in Diesel injection pipes, hydraulic conduits, engine intake, and exhaust pipes. *Professor DeJuhasz*

Eng. Exp. Sta. 506. Research in Transient Elastic Phenomena (3-15 per semester) Laboratory research in the fields described under Eng. Exp. Sta. 505. *Professor DeJuhasz*

Eng. Exp. Sta. 507. Scavenging of Two-Stroke Cycle Engines (3) Design of ports, valves, blowers, intake and exhaust manifolds for proper scavenging and charging of engines, particularly two-stroke cycle Diesel engines; experimental technique in evaluating scavenging. Prerequisite: M.E. 107 or 413. *Professor Schweitzer*

Eng. Exp. Sta. 508. Fuel Feeding Devices for Internal Combustion Engines (3) Carburetors and injection equipment for Otto and Diesel engines and for liquid-fuel turbines, including the required control devices. *Professor Meyer*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Eng. Exp. Sta. 401. Theory of Engineering Instruments (2-3) *Professor DeJuhasz*

ENGINEERING MECHANICS

Professor John A. Sauer, M.S., Ph.D.
Head of the Department

Mchs. 500. Advanced Mechanics of Materials (3-6) Strain energy methods; special problems in bending and torsion; curved bars, beams on elastic foundations; thick-walled cylinders, shrink-fit assemblies, and rotating discs; thin-walled pressure vessels; bending of thin plates; buckling of bars and plates. Prerequisite: Mchs. 13. *Professors Marin and Hardenbergh*

Mchs. 504. Applied Elasticity (3) Analyses of stress and strain in two dimensions; problems in elasticity and elastic stability; emphasis on applications to machine and structural design. Prerequisite: Mchs. 13. *Professor Marin*

Mchs. 506. Experimental Stress Analysis (3) Experimental methods of stress determination including photoelasticity, stress coat and electric strain gauge techniques; stress analogies; strain rosettes for combined stress determinations. Prerequisite: Mchs. 13. *Professor Marin*

Mchs. 507. Theory of Elasticity and Applications (3-6) General equations of stress and strain; applications to beams, curved members, rotating discs, thick cylinders, torsion members, plates, and other structural and machine parts. Prerequisite: Mchs. 13. *Professor Sauer*

Mchs. 508. Theory of Elastic Stability and Applications (3) Buckling of slender and short members; buckling of I-beams; stability of thin-walled constructions; thin-walled cylinders subjected to internal pressures; applications to structural parts including aircraft members. Prerequisites: Mchs. 12, 13.

Mchs. 509. Theory of Plates and Shells (3) Bending of circular and rectangular plates; buckling of plates; plates on elastic foundations; deformation of shells without bending; applications to engineering problems. Prerequisite: Mchs. 13.

Mchs. 512. History of Mechanics of Materials (2) Prerequisite: Mchs. 13.

Mchs. 513. Thesis (1-9)

Mchs. 514. Engineering Mechanics Seminar (1 per semester) Current literature and special problems in engineering mechanics. *Professor Roos*

Mchs. 515. Research in Engineering Mechanics (1-15 per semester) Investigation of a theoretical or experimental project in engineering mechanics.

Mchs. 520. Advanced Dynamics (3) Dynamics of a particle and of rigid bodies; Newtonian equations in moving co-ordinate systems; LaGrange's and Hamilton's equations of motion; special problems in vibrations and dynamics. Prerequisites: Mchs. 12, Math. 84 or 431. *Professor Sauer*

Mchs. 522. Theory of Vibrations (3) Mathematical theory of vibrating systems; damping phenomena; forced vibrations; analogy between mechanical and elec-

trical vibrations; transverse and torsional oscillation of shafts; vibration of strings, beams, membranes, and plates. Prerequisites: Mchs. 13, Math. 84 or 431.
Professors Sauer and Vierck

Mchs. 523. Vibration Problems in Engineering (3) Application of vibration theory to problems of suspension; vibration isolation in machines, ships, and automobiles; torsional oscillation of crankshafts; vibrations of bridges, turbine blades, propeller blades; self-induced vibrations; nonlinear vibrational systems and applications. Prerequisite: Mchs. 522.

Mchs. 530. Mechanical Properties of Materials and Design (3) True stress-strain relations in tension; plastic stress-strain equations for combined stresses; theories of failure for static and fatigue stresses; impact loads; creep of metals; applications to structural and machine design. Prerequisite: Mchs. 14.
Professor Marin

Mchs. 531. Theory of Plasticity and Applications (3) Theory of plasticity including plastic torsion and bending of bars; thick-walled cylinders and rotating discs; buckling of bars and residual stresses; mechanics of creep. Prerequisite: Mchs. 504 or 507. *Professor Marin*

Mchs. 533. Determination of Mechanical Properties (3) Experiments in fatigue, creep, impact, and combined stresses; true stress-strain diagrams.
Professor Roos

Mchs. 540. Mechanics of Continua (3) A unified mathematical treatment of the elements of fluid mechanics and of the elasticity and plasticity of solids. Prerequisite: Math. 84 or 431. *Professor Lessen*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Mchs. 400. Advanced Strength of Materials (3)
Professors Marin and Hardenbergh
Mchs. 401, 401X. Elements of Vibrations (3) *Professors Vierck and Sauer*
Mchs. 402. Applied and Experimental Stress Analysis (3) *Professor Marin*
Mchs. 403. Mechanical Properties of Materials and Design (3)
Professor Marin
Mchs. 404. Research in Engineering Mechanics (1-6)

ENGLISH

Professor Theodore J. Gates, M.A.
Head of the Department of English Composition

Professor Brice Harris, M.A., Ph.D.
Head of the Department of English Literature

Engl. 501. Materials and Methods of Research (3) The bibliography of literary history and criticism; methods of editing and annotating texts; the form and

materials of dissertations. Required of all graduate students with an English major. *Professor Ridenour*

ENGL. 502. ANCIENT AND MEDIEVAL RHETORIC AND POETIC (3) Rhetorical and poetic doctrine of ancient and medieval times. *Professor Krauss*

ENGL. 507. RESEARCH PROBLEMS IN ENGLISH (1-6) The methods of research in English, the problems of bibliography, and the method of evaluating sources and materials.

ENGL. 508. BEOWULF (3) A reading of the text and a study of the prominent literary problems and relationships. Prerequisite: Engl. Lit. 31. *Professor Mead*

ENGL. 509. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE PROSE WRITERS (3) *Professor Mead*

ENGL. 510. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE POETS (3) *Professor Locklin*

ENGL. 511. ELIZABETHAN DRAMA (3) *Professor Harris*

ENGL. 514. SHAKESPEARE (3) Special problems in the works of Shakespeare. *Professor Bowman*

ENGL. 515. THE AGE OF SWIFT (3) Special studies varying from year to year. *Professor Harris*

ENGL. 516. THE AGE OF JOHNSON (3) The work of Johnson and his circle. *Professor Mead*

ENGL. 517. BYRON, SHELLEY, AND KEATS (3) *Professor Ridenour*

ENGL. 518. PRE-ROMANTIC WRITERS (3) Development of Romantic ideas in the 18th century. *Professor Ridenour*

ENGL. 519. WORDSWORTH, COLERIDGE, SOUTHEY, AND SCOTT (3) *Professor Ridenour*

ENGL. 531. OLD ENGLISH (3) Old English language and literature with lectures on Old English and Germanic philology. *Professor Mead*

ENGL. 532. MIDDLE ENGLISH (3) Middle English language and literature with lectures on the development of Old English through Middle English to modern times. *Professor Mead*

ENGL. 533. LITERARY CRITICISM (3) An historical survey of the principles of literary criticism.

ENGL. 534. HISTORICAL ENGLISH GRAMMAR (3) The evolution of the grammatical system of English. *Professor Peck*

ENGL. 535. RENAISSANCE AND MODERN RHETORIC (3) The rhetorical and poetic doctrine of Renaissance and modern times. *Professor Rubin*

ENGL. 540. CHAUCER (3) Analysis of Chaucer's poetry in the light of its background, sources, and subsequent influences. *Professor Mead*

ENGL. 542. PROSE STYLE (3) The development of English prose style from the Elizabethan age to Dryden. *Professor Major*

ENGL. 543. CAVALIER AND ANGLICAN (3) The poetry and prose of the middle years of the 17th century from the death of Shakespeare to 1660. *Professor Mead*

ENGL. 544. RESTORATION LITERATURE (3) Selected studies in the writers in England between 1650 and 1700. *Professor Harris*

ENGL. 545. POETS OF THE VICTORIAN PERIOD, EXCLUSIVE OF TENNYSON AND BROWNING (3) *Professor Long*

ENGL. 546. TENNYSON AND BROWNING (3) *Professor Long*

ENGL. 547. PROSE WRITERS OF THE VICTORIAN PERIOD (3) *Professor Long*

ENGL. 550. SELECTED STUDIES IN THE BRITISH NOVEL TO 1840 (3) *Professor Bowman*

ENGL. 551. SELECTED STUDIES IN THE BRITISH NOVEL FROM 1840 TO THE PRESENT (3) *Professor Sutherland*

ENGL. 553. MODERN PROSE STYLE (3) English prose style from 1700 to the present. A continuation of Engl. 542. *Professor Major*

ENGL. 554. RHETORICAL TECHNIQUES (3) Studies in the techniques of special types of writing, such as humor, satire, and propaganda. Prerequisites: 12 credits in English or American literature and 12 credits in English composition. *Professor Graves*

ENGL. 562. HISTORY OF THE AMERICAN NOVEL (3) *Professor Werner*

ENGL. 563. AMERICAN ESSAYS (3) Lectures and reports on a special group of essayists. *Professor Werner*

ENGL. 565. THE AMERICAN SHORT STORY (3) *Professor Werner*

ENGL. 566. HISTORY OF AMERICAN POETRY (3) *Professor Werner*

ENGL. 567. ANGLO-AMERICAN FOLK SONG (3) Oral tradition of melodies and texts; types, regions, theories. *Professor Bayard*

ENGL. 580. PRE-SHAKESPEAREAN DRAMA (3) *Professor Harris*

ENGL. 599. THESIS (1-15 per semester)

ENGLISH COMPOSITION

Professor Theodore J. Gates, M.A.
Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

Engl. Comp. 404. Public Opinion and Written Persuasion (3) *Professor Graves*
Engl. Comp. 410a,b,cS. Survey of English Composition (1-3)
Engl. Comp. 411a,b,cS. Spoken and Written English (1-3)
Engl. Comp. 418. The Writing of Literary Criticism (3) *Professor Rubin*

ENGLISH LITERATURE

Professor Brice Harris, M.A., Ph.D.
Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

Engl. Lit. 400. Teachers' Course in Literature (3) *Professor Merrill*
Engl. Lit. 401. Main Currents in American Literature (3) *Professor Merrill*
Engl. Lit. 423. Forms and Movements of British Literature (3) *Professor Ridenour*
Engl. Lit. 439a,b,cS. Our Contemporaries (3)
Engl. Lit. 440a,b,cS. Masters of Literature (1-3)
Engl. Lit. 441a,b,cS. Masters of English Literature (1-3)
Engl. Lit. 460. Literary Biography (3) *Professor Merrill*
Engl. Lit. 464. Spenser (3) *Professor Locklin*
Engl. Lit. 466. Milton (3) *Professor Harris*
Engl. Lit. 475a,b,cS. World Literature in English (3-9)
Engl. Lit. 484. American Drama (3) *Professor Cloetingh*
Engl. Lit. 485. Scandinavian Drama (3) *Professor Cloetingh*
Engl. Lit. 486. Later British and Irish Dramatists (3) *Professor Cloetingh*
Engl. Lit. 487. Modern Continental Drama (3) *Professor Cloetingh*
Engl. Lit. 489a,b,cS. Composite Course in Drama (3-9)
Engl. Lit. 489dS. Contemporary Drama (3)

ENTOMOLOGY

Professor Edward H. Dusham, M.S., Ph.D.
Head of the Department of Zoology and Entomology

Ent. 505. Advanced Morphology of Insects (3) Advanced work in either the external or internal morphology of insects. Prerequisites: Ent. 403, 405.

ENT. 506. IMMATURE INSECTS (2) The morphology and taxonomy of the immature stages of insects. Prerequisites: Ent. 403, 405. *Professor Frost*

ENT. 508. THE BIOLOGICAL CONTROL OF INSECTS (2) The artificial use of bacteria, fungous diseases, and animals in the control of injurious insects; methods and equipment for rearing parasites and predators on a large scale. Prerequisites: Ent. 6, 8, 407. *Professor Frost*

ENT. 509. ENTOMOLOGICAL TECHNIQUE (2) For advanced students dealing with special methods of collecting, rearing living insects, preparing and preserving immature stages, keeping records, and preparing illustrations for manuscript. Prerequisite: Ent. 6. *Professor Frost*

ENT. 513. ENTOMOLOGICAL RESEARCH (1-15 per semester) Prerequisites: Ent. 405, 407.

ENT. 514. ADVANCED SYSTEMATIC ENTOMOLOGY (1-15 per semester) Taxonomy of the various orders of insects selected to meet the needs of the individual student. Prerequisites: Ent. 403, 405.

ENT. 528. INSECT PHYSIOLOGY (3) The normal functions of the insect body. Prerequisites: Ent. 405, Zool. 41. *Professor Dills*

ENT. 534. INSECT EMBRYOLOGY (2) The origin and development of the tissues and organs of insects. Prerequisites: Ent. 403, 405. *Professor Newman*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ENT. 401. MEDICAL AND VETERINARY ENTOMOLOGY (3) *Professor Frings*
ENT. 403. SYSTEMATIC ENTOMOLOGY (3)
ENT. 405. INSECT MORPHOLOGY (3)
ENT. 407. INSECT ECOLOGY (3) *Professor Frost*
ENT. 413. ENTOMOLOGY SEMINAR (1 per semester) *Professor Frost*
ENT. 429. PRINCIPLES OF INSECT CONTROL (2) *Professor Frost*
ENT. 430. INSECT HISTOLOGY (2)
ENT. 431. ENTOMOLOGICAL PROBLEMS (1-6)

FAMILY ECONOMICS AND HOME MANAGEMENT

PROFESSOR DELPHA E. WIESENDANGER, M.S.
Acting Head of the Department of Home Management, Housing, and Art

H. MGMT. 500. RESEARCH IN FAMILY ECONOMICS OR HOME MANAGEMENT (1-6 per semester)

H. MGMT. 501. THESIS (1-15)

H. Mgmt. 515, 515X. Consumer Problems (2-3) Methods of securing, evaluating, and presenting data concerning household commodities. For home economics teachers in high schools, colleges, and adult classes. Prerequisites: Fd. Ntr. 212, H. Mgmt. 442. *Professor Honey*

H. Mgmt. 524. Economic Problems of the Household (3) Economic problems of the present-day family; special emphasis on factors in household production, use of money income, and standards of living. Prerequisites: H. Mgmt. 439, Econ. 14. *Professor Honey*

H. Mgmt. 528. Home Management Supervision (2-3) Evaluation of objectives and techniques in the organization, supervision, and teaching of the home management house experience. Prerequisite: H. Mgmt. 439.

H. Mgmt. 543. Home Management in Relation to Family Living (3) Includes work with families in solution of their management problems. Prerequisites: Fd. Ntr. 212, H. Mgmt. 439. *Professor Wiesendanger*

H. Mgmt. 544. Special Problems in House Management (3) Specific management problems, such as social, financial, and material, including the development of college level teaching aids. Prerequisite: 6 credits of home management or family economics courses in home economics. *Professor Wiesendanger*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

H. Mgmt. 439, 439X. Home Management (2) *Professor Starr*
H. Mgmt. 442. Resident Experience in Home Management (3) Room and board will be charged at regular rates. *Professor Starr*
H. Mgmt. 445. Home Management Experience (3) *Professor Starr*
H. Mgmt. 477. Family Management (3)

FOODS, NUTRITION, AND HEALTH

Professor Mary L. Dodds, M.S., Ph.D.
Acting Head of the Department

Fd. Ntr. 500. Research in Foods and Nutrition (1-6 per semester)

Fd. Ntr. 501. Thesis (1-15)

Fd. Ntr. 520. Readings in Foods (3) Readings and discussion of selected food problems.

Fd. Ntr. 521. Seminar in Foods (1-6) Discussion and reports on current research in the foods field. Prerequisite or concurrent: Fd. Ntr. 520.

Fd. Ntr. 522. Individual Food Problems (2-6) Intensive study of specific problems in food preparation. Prerequisite: Fd. Ntr. 420.

Fd. Ntr. 523. Economic and Nutritional Phases of Menu Planning (2-4) Food expenditures in relation to nutritional value and income. Prerequisites: Fd. Ntr. 450, Econ. 14.

Fd. Ntr. 550. Readings in Nutrition (3) Readings and reports of selected topics in nutrition. Prerequisite: Fd. Ntr. 450.

Fd. Ntr. 551. Nutrition Seminar (3-6) Selected topics and recent advances in nutrition. Prerequisite: Fd. Ntr. 450.

Fd. Ntr. 552. Diet in Diseases (3) Reports and discussions of the problems of adaptation of diet to disorders of nutrition. Prerequisites: Fd. Ntr. 450.

Fd. Ntr. 553. Nutrition of Children (3) The nutritional needs of the normal child during prenatal life, infancy, and childhood. Prerequisites: Agr. Biochem. 35, Fd. Ntr. 450.

Fd. Ntr. 554. Techniques in Human Nutrition Research (3) The more usual techniques employed by the research worker in human nutrition, accompanied by directed experience in their use and interpretation. Prerequisite or concurrent: Fd. Ntr. 551.

Fd. Ntr. 555. Field Work in Nutrition (2-4) Field problems planned to meet needs of individual students. Prerequisite: Fd. Ntr. 450. Hours and problems to be arranged.

Fd. Ntr. 556. The Survey Method in Foods and Nutrition (2) A study of survey technique as a tool in the assay of food adequacy and nutritional status.
Professor Dodds

Fd. Ntr. 557. Interrelationships of Nutrients (2) Interrelationship of nutrients in metabolic processes, their significance as applied to nutrition and in terms of the contribution of food stuffs. Prerequisites: Fd. Ntr. 450, Agr. Biochem. 437.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fd. Ntr. 420. Experimental Cookery (1-6) *Professor Olson*
Fd. Ntr. 421. Advanced Foods (3) *Professor Levcowich*
Fd. Ntr. 425. Food Preservation (1-2)
Fd. Ntr. 426. Recent Developments in Foods (3)
Fd. Ntr. 450. Nutrition (4) *Professors Padgett and Pike*
Fd. Ntr. 451. Family Nutrition (3) *Professor Padgett*
Fd. Ntr. 452. Elements of Diet in Disease (3) *Professor Pike*
Fd. Ntr. 453. Diet Therapy (3) *Professor Padgett*
Fd. Ntr. 455. Teaching Nutrition to Boys and Girls (3)
Fd. Ntr. 491, 491v. Teaching Home Nursing (1)

FORESTRY

PROFESSOR VICTOR A. BEEDE, M.F.
Head of the Department

FOR. 500. NATIONAL AND STATE ADMINISTRATION (3-5) Comparison of the policy and administration of the national forests with the forests of other countries and of the different states. *Professor Beede*

FOR. 502. WOOD FIBERS (3-5) Identification and physical and chemical characteristics of wood fibers used for pulp, either for paper or as a source of cellulose. Pulping quality, fiber measurements. *Professor White*

FOR. 504. RESEARCH METHODS IN FORESTRY (2-6 per semester) Review of methods employed in conducting forestry research. *Professor Bramble*

FOR. 508. FOREST ECOLOGY (2-4) The organization, development, and classification of forest communities. *Professor Bramble*

FOR. 509. COVERT MANAGEMENT (2) Management of forest associations for maintenance and development of wildlife. Prerequisite: For. 508. *Professor Bramble*

FOR. 510. SEMINAR (1-2 per semester) Current problems of forest research presented as weekly seminar reports. May be repeated with additional credit for each semester's work. *Professor Bramble*

FOR. 530. RESEARCH IN WOOD UTILIZATION (3-6 per semester) Research in some phase of wood utilization or forest products. Prerequisite: For. 431. *Professor Norton*

FOR. 531. STRUCTURAL USES OF WOOD AND WOOD PRODUCTS (3-6 per semester) Wood as a construction material; testing techniques for structural timbers and wood assemblies; use of laminated wood, ring connectors, and other types of special construction. Prerequisite: For. 404. *Professor Norton*

FOR. 532. LAMINATES (3-6 per semester) Advanced and special studies in the fabrication and use of plywood, laminated wood, paper-base laminates, and wood-to-metal bonding. Prerequisite: For. 405. *Professor Norton*

FOR. 535. CONDITIONING TREATMENTS FOR WOOD (3-6 per semester) Advanced study and problems in preservative, seasoning, and other special treatments for wood and wood products. Prerequisite: For. 435. *Professor Norton*

FOR. 550. FOREST MENSURATION (2-8 per semester) Research in some chosen field. Prerequisite: For. 450. *Professor Meyer*

FOR. 560. FOREST MANAGEMENT (3-8) Special topics in forest management and research in some chosen field. Prerequisite: For. 466. *Professor Meyer*

FOR. 575. APPLICATIONS OF FOREST ECONOMICS AND FINANCE (3 per semester) Survey of situations in forestry where business problems and particular circumstances of production, value, and costs are currently significant. Prerequisite: For. 70. *Professor Humphrey*

FOR. 590. THE LUMBER INDUSTRY (2-4) The relation of the lumber industry to national economy and world trade; lumberman's associations; lumber accounts. Prerequisite: For. 430.

FOR. 591. PROBLEMS IN LUMBERING (2-6) Research in some chosen phase of lumbering. Prerequisite or concurrent: For. 590.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

FOR. 400.	ADVANCED SILVICULTURE (2)	*Professor Bramble*
FOR. 402.	FOREST RESEARCH (2)	*Professor Bramble*
FOR. 404.	MECHANICAL PROPERTIES OF WOOD (3)	*Professor Norton*
FOR. 405.	VENEER AND PLYWOOD (3)	*Professor Norton*
FOR. 406.	FORESTRY LITERATURE (1)	*Professor White*
FOR. 417.	NATIONAL AND STATE FOREST PRACTICE (2)	*Professor Beede*
FOR. 421.	REGIONAL SILVICULTURE (4)	*Professor Cope*
FOR. 427.	FOREST USES (3)	*Professor Bramble*
FOR. 430.	FOREST PRODUCTS AND INDUSTRIES (3)	*Professor Norton*
FOR. 431.	ADVANCED UTILIZATION (2-4)	*Professor Norton*
FOR. 435.	SEASONING AND PRESERVATION (3)	*Professor Norton*
FOR. 445.	IMPROVEMENTS (3)	
FOR. 446.	FOREST PARK ADMINISTRATION (3)	
FOR. 450.	ADVANCED MENSURATION (2)	*Professor Meyer*
FOR. 451.	STATISTICS IN FORESTRY AND WOOD UTILIZATION (3)	*Professor Meyer*
FOR. 455.	AERIAL PHOTOGRAMMETRY IN FOREST MANAGEMENT (2)	
FOR. 462.	ADVANCED WOOD TECHNOLOGY (2)	*Professor White*
FOR. 466.	FOREST MANAGEMENT AND MANAGEMENT PLANS (4)	*Professor Meyer*
FOR. 468.	SILVICULTURAL RESEARCH (2-4)	*Professor Bramble*
FOR. 469.	PROBLEMS IN FOREST MANAGEMENT (3)	*Professor Meyer*
FOR. 475.	PROBLEMS IN FOREST ECONOMICS AND FINANCE (3)	*Professor Humphrey*
FOR. 480.	POLICY AND ADMINISTRATION (3)	*Professor Beede*
FOR. 491.	LUMBERING (3)	
FOR. 492.	LUMBER DISTRIBUTION (3)	
FOR. 494.	LOGGING (3)	
FOR. 495.	MILLING (3)	
FOR. 497.	SMALL SAWMILLS (3)	

FRENCH

PROFESSOR ROBERT J. CLEMENTS, M.A., Ph.D.
Head of the Department of Romance Languages

ACADEMIC YEAR

FR. 544. NEOCLASSICISM IN THE ROMANCE LITERATURES (3) The nature and de-

velopment of the Neoclassic movement in Italy, France, Spain, and Portugal. Prerequisite: Fr. 40.

Fr. 545. Romanticism in the Romance Literatures (3) The nature and development of the Romantic movement in Italy, France, Spain, and Portugal.

Fr. 546. Medieval Romance Literatures (3) The nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal.

Fr. 547. Realism, with Particular Reference to Romance Literatures (3)

Fr. 548. 20th Century Romance Literature as a Political Force (3)

Fr. 551. Romance Philology (3) Historical development of the Romance languages.

Fr. 552. Old and Middle French Readings and Literature (3) Familiarizes the student with Old and Middle French texts from the earliest monument to Villon. Prerequisite: Fr. 551.

Fr. 553. French Literature of the Renaissance (3) The French Renaissance from 1498 to 1548.

Fr. 554. The Renaissance in the Romance Literatures (3) Themes and forms of literature in the humanistic period.

Fr. 557. French Romantic Poetry (3)

Fr. 562. French Thinkers of the 18th Century (3)

Fr. 564. French Romanticism (3) The French Romantic Movement after 1830.

Fr. 570. Voltaire and Rousseau (3)

Fr. 571. Seminar in French Literature (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

Fr. 572. Seminar in French Literature (3) Continuation of Fr. 571.

Fr. 580. Proust and Gide (3)

Fr. 599. Dissertation (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fr. 400. French Literature of the 16th Century (3)
Fr. 401. French Theater of the Classical Period (3)
Fr. 403. French Dramatic Literature of the 18th Century (3)
Fr. 405. French Literature of the 19th Century (3)
Fr. 406. French Literature of the 19th Century (3)
Fr. 407. French Novel of the 19th Century (3)

Fr. 410. French Poetry of the 19th Century (3)
Fr. 411. French Literature of the 20th Century (3)
Fr. 413, 413X. Contemporary French Drama (3)
Fr. 415. French Novel of the 18th Century (3)
Fr. 421. The Teaching of Romance Languages (3)
Fr. 471. Problems in French Literature (3-6)
Fr. 490. Advanced Composition and Conversation (3)
Fr. 496. Literary Criticism in France, Italy, and Spain (3)

MAIN SUMMER SESSION

Fr. 505S. The Great Writers of France (2)
Fr. 507S. La Fontaine and His Time (2)
Fr. 528S. French Lyric Poetry of the 19th Century (2)
Fr. 531S. French Novelists of the Romantic School (2)
Fr. 538S. The Romantic Poets (2)
Fr. 540S. Contemporary French Drama (2)
Fr. 541S. Modern French Drama (2)
Fr. 542S. The French Short Story of the 19th Century (2)
Fr. 555S. Victor Hugo and His Time (2)
Fr. 556S. Charles Baudelaire (2)
Fr. 557S. French Romantic Poetry (2)
Fr. 559S. France Between Two Wars (2)
Fr. 560S. Moliere and the Classical Comedy (2)
Fr. 565S. French Literature of the 19th Century (2)
Fr. 566S. Classical French Literature (2)
Fr. 567S. The French Novel from 1870 to 1914 (2)
Fr. 568S. The Contemporary Novel (2)
Fr. 570S. Voltaire and Rousseau (2)
Fr. 575S. Advanced Phonetics (2)
Fr. 576S. Composition and Stylistics (2)
Fr. 577S. Advanced Composition and Stylistics (3-6)
Fr. 579S. Research Laboratory in Phonetics (1)
Fr. 587S. French Novelists of the 18th Century (2)
Fr. 588S. French Poetry: from Baudelaire to the Symbolists (2)
Fr. 591S. French in the Secondary Schools (3)
Fr. 592S. French and Spanish in the Secondary Schools (3)
Fr. 599S. Dissertation (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fr. 409S. Advanced Course in Pronunciation and Conversation (2)
Fr. 469S. French Civilization of the 19th Century (2)
Fr. 493S. Elementary Phonetics (2)
Fr. 495S. Advanced Composition and Syntax (3)
Fr. 498S. Intermediate Phonetics (2)

FUEL TECHNOLOGY

PROFESSOR C. C. WRIGHT, Ph.D.
Chief of the Division

FUEL T. 501. COAL PETROGRAPHY (2) The microscopic examination of coals for the determination of coal type and vegetable origin. Prerequisite or concurrent: Fuel T. 503. *Professor Kinney*

FUEL T. 502. RESEARCH DATA (3) Methods of obtaining and interpreting research data; designed for the graduate student beginning laboratory research. Prerequisite: Math. 30. *Professor Nielsen*

FUEL T. 503. CHEMICAL CONSTITUTION AND SCIENTIFIC CLASSIFICATION OF COAL (3-6) The chemistry of plant constituents in relation to coal and the coalification process; constitution of coal as deduced by chemical methods; scientific classification of coals. Prerequisite: Chem. 31. *Professor Kinney*

FUEL T. 504. FUEL TECHNOLOGY RESEARCH (1-15 per semester) Original research on preparation, carbonization, processing, utilization, or constitution of fuels. Results of the investigation may be used as the thesis. Prerequisites: Fuel T. 502, 503. *Professor Wright and Staff*

FUEL T. 505. PHYSICOCHEMICAL PROPERTIES OF COAL, MINERAL MATTER, AND ASH (3) Physical, physicochemical, and use properties; their significance and applications. Prerequisite: Chem. 41.

FUEL T. 506. ADVANCED COMBUSTION (3) Advanced combustion and heat balance calculations, ignition and flame characteristics of fuels; furnace atmospheres; selection of fuels with reference to use and equipment. Prerequisite: Chem. 41. *Professor Wright*

FUEL T. 507. ADVANCED THERMAL PROCESSING (3) Pyrolysis, coal carbonization, coke manufacture and uses; action of heat on coals and fuels; technical and economic factors. Prerequisites: Chem. 35, 41, or Min. Prep. 410.

FUEL T. 508. SYNTHESIS OF LIQUID FUELS (3) Chemical nature of liquid hydrocarbons; preparation of hydrogen and synthesis gas; theoretical and practical aspects of synthetic liquid fuel processes. Prerequisites: Chem. 31, Fuel T. 402.

FUEL T. 509. TECHNOLOGY OF TARS (3) Formation, constitution, physical and chemical properties of coal, oil-gas and water-gas tar; processing and utilization. Prerequisite: Chem. 31. *Professor Polansky*

FUEL T. 510. FUEL TECHNOLOGY PROBLEM (1-6 per semester) Special problems in fuel technology. Prerequisite: Fuel T. 503. *Professor Wright and Staff*

FUEL T. 511. FUEL TECHNOLOGY SEMINAR (1-6) Selected topics from current fuel technology research examined and discussed. Prerequisite: Chem. 35 or 41. *Professor Wright and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

FUEL T. 400. FUEL TECHNOLOGY RESEARCH AND DESIGN (1-3) *Professor Wright and Staff*

FUEL T. 401. FUEL GASES AND GASIFICATION (3) *Professor Wright*

FUEL T. 402. CHEMICAL PROCESSING OF FUELS (2)

FUEL T. 403. ENERGETICS OF FUEL TECHNOLOGY (3) *Professor Gauger*

FUEL T. 404. FUEL TECHNOLOGY DESIGN (3) *Professor Spicer*

GENERAL HOME ECONOMICS

PROFESSOR HELEN R. LEBARON, M.S., Ph.D.
Assistant Dean of the School of Home Economics

GEN. H.E. 500. RESEARCH IN GENERAL HOME ECONOMICS (1-6 per semester)

GEN. H.E. 501. THESIS (1-15)

GEN. H.E. 516, 516v. METHODS OF RESEARCH IN HOME ECONOMICS (3) Review of problems and techniques of research in home economics. Required of all graduate students in home economics. *Professor Hatcher*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GEN. H.E. 400, 400v, 400X, 400vX. RECENT FINDINGS IN HOME ECONOMICS (2-3)

GEOGRAPHY

PROFESSOR E. WILLARD MILLER, M.A., Ph.D.
Chief of the Division

GEOG. 503. ADVANCED REGIONAL GEOGRAPHY (3-12) Intensive study at an advanced level of selected regions or sections of the continents. Prerequisite: 12 credits in geography. *Professors Miller and Deasy*

GEOG. 504. PHYSICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of physical geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professors Miller and Deasy*

GEOG. 505. ECONOMIC GEOGRAPHY SEMINAR (3-12) The literature of some phase of economic geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor Miller*

GEOG. 506. CULTURAL AND POLITICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of cultural and political geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor Griess*

GEOG. 510. PHYSICAL GEOGRAPHY RESEARCH (3-10) Original study in physical geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Deasy*

GEOG. 511. ECONOMIC GEOGRAPHY RESEARCH (3-10) Original study in economic geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Miller*

GEOG. 512. CULTURAL AND POLITICAL GEOGRAPHY RESEARCH (3-10) Original study in cultural and political geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Griess*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GEOG. 400.	REGIONAL GEOGRAPHY OF NORTH AMERICA (3)	*Professor Deasy*
GEOG. 401.	REGIONAL GEOGRAPHY OF PENNSYLVANIA (3)	*Professor Miller*
GEOG. 402.	REGIONAL GEOGRAPHY OF MIDDLE AMERICA (3)	*Professor Griess*
GEOG. 403.	REGIONAL GEOGRAPHY OF SOUTH AMERICA (3)	*Professor Griess*
GEOG. 405.	CULTURAL GEOGRAPHY (3)	*Professor Griess*
GEOG. 433.	REGIONAL CLIMATOLOGY (3)	*Professor Deasy*
GEOG. 435.	FIELD METHODS IN GEOGRAPHY (3)	*Professor Miller*
GEOG. 442.	GEOGRAPHY OF EUROPE (3)	*Professor Miller*
GEOG. 443.	GEOGRAPHY OF THE ORIENT (3)	*Professor Deasy*
GEOG. 444.	GEOGRAPHY OF AFRICA (3)	*Professor Griess*
GEOG. 445.	GEOGRAPHY OF THE AIR AGE (3)	*Professor Miller*
GEOG. 452.	INTERPRETATION OF AERIAL PHOTOGRAPHS (3)	*Professor Deasy*
GEOG. 460.	POLITICAL GEOGRAPHY (3)	*Professor Griess*
GEOG. 480.	GEOGRAPHY OF WORLD MANUFACTURING (3)	*Professor Miller*

GEOLOGY

PROFESSOR FRANK M. SWARTZ, Ph.D.
Chief of the Division

*GEOL. 500. GEOLOGY SEMINAR (1-9) Presentation, at weekly departmental meetings, of topics selected from geological literature.

†GEOL. 501. STRATIGRAPHY (3-12) Principles of stratigraphic classification, lithofacies and biofacies, faunal zonation, correlation, sedimentation, and paleogeography, illustrated by stratigraphy of classical geologic regions: (a) Pre-Cambrian; (b) Paleozoic; (c) Mesozoic; (d) Cenozoic. Prerequisite: Geol. 464. *Professor Swartz*

‡GEOL. 502. GEOLOGICAL RESEARCH (3-18) An original investigation of a geologi-

* Credits to be arranged, 1 to 6 per semester.
† Credits to be arranged, 3 to 6 per semester.
‡ Credits to be arranged, 3 to 9 per semester.

cal problem approved by the chief of the division. Results of the investigation may be used for the thesis.

†Geol. 503. Paleontology (3-9) Morphology of animal groups significant for their fossils; nature of species and faunal zones. Seminars may be arranged for studies of special fossil groups, microfossils, paleoecology. *Professor Swartz*

§Geol. 504. History of Geology (2-3) Development through the ages of the scientific method in the earth sciences. *Professor Krynine*

†Geol. 507. Geomorphology (3-9) Processes involved in the development of land forms; relationships to structural and lithologic features; interpretation of the history of development; principles of description and classifiiation. Prerequisite: Geol. 32. *Professor Miller*

†Geol. 508. Dynamical Geology (3-6) Dynamics of external earth processes of mass wasting, currents and waves, wind action, ice movements; and of internal processes of diastrophism and vulcanism. Prerequisite: Geol. 483. *Professor Miller*

†Geol. 509. Volcanology (3-6) Volcanic phenomena, structures, land forms, and great modern eruptions, in relation to dynamics of extrusion, geographic and stratigraphic distribution, classification. Prerequisite: Geol. 32.

†Geol. 511. Ore Deposits: Principles (3-6) Geological and geochemical processes controlling ore deposition; genetic classification of ore deposits. Prerequisite: Geol. 451. *Professor Ridge*

†Geol. 512. Ore Deposits: Types (3-6) Geologic history of selected ore bodies with respect to forming media; cause, sequences, and loci of emplacement; wall rock alteration and secondary enrichment. Prerequisite: Geol. 511. *Professor Ridge*

†Geol. 513. Ore Deposits: Chemical Prospecting (3-6) Methods of prospecting using techniques of geochemical, biochemical, and hydrochemical analysis. Prerequisites: Chem. 20, Geol. 451. *Professor Ridge*

Geol. 514. Ore Deposits: Field Study (1-2) Field study of ore deposits in eastern Pennsylvania, northern New Jersey, the Adirondacks, and eastern Ontario. Prerequisite: Geol. 512. *Professor Ridge*

Geol. 515. Ore Microscopy (2-3) Theory and use of the ore microscope in identifying ore minerals in polished section, establishing paragenetic sequences, determining manner of deposition. Prerequisite: Geol. 513. *Professor Ridge*

†Geol. 520. Paleobotany (3-6) Classification, morphology, nomenclature, and stratigraphic occurrence of fossil plants. Prerequisite: Geol. 32. *Professor Spackman*

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† Credits to be arranged, 3 to 6 per semester.
§ Credits to be arranged, 2 or 3 per semester.

*Geol. 524. Geology of Coal (1-6) Origin, geologic modifications, microscopy of coal; relations to enclosing sediments; geologic and geographic distribution. Prerequisite: Geol. 32 or Chem. 35. *Professor Spackman*

†Geol. 530. Geological Problems (3-6) Study, from the literature, of a selected geological problem. Prerequisite: 10 credits of geology and mineralogy.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Geol. 451.	Economic Geology (3)	*Professor Ridge*
Geol. 461.	Physiography of the United States (3)	*Professor Miller*
Geol. 464.	Paleontology (3)	*Professor Swartz*
Geol. 481.	Geology of Oil and Gas (3)	
Geol. 482.	Metallic Mineral Deposits (3)	*Professor Ridge*
Geol. 483.	Structural Geology (3)	*Professor Swartz*
Geol. 484.	Paleozoic Stratigraphy (3)	*Professor Swartz*
Geol. 485.	Paleontology (2)	*Professor Swartz*
Geol. 486.	Stratigraphic Methods (1)	*Professor Swartz*
Geol. 488.	Earth Sciences Seminar (1)	
Geol. 489.	Earth Sciences Report (1)	

GEOPHYSICS AND GEOCHEMISTRY

Professor B. F. Howell, Jr., M.S., Ph.D.
Chief of the Division

Geophys. 500. Geophysical Seminar (1 per semester) Discussion of geophysical reports and papers; scientific outlook. Prerequisites: Geophys. 401, 402. *Professor Howell*

Geophys. 501. Geophysical Research (3-12) Research work in theoretical and applied geophysics; especially the branches of seismology and geophysical methods of exploration. *Professor Howell*

Geophys. 502. Seismic Instruments (2) Characteristics and design of seismometers and seismic recorders. Given alternate years. Prerequisites: Phys. 285, differential equations. *Professor Howell*

Geophys. 503. Special Studies in Geophysics (1-9) Special studies of the theories of geophysical methods. Prerequisite: 6 credits in geophysics. *Professor Howell*

Geophys. 507. Seismology (3) Nature and transmission of seismic waves; cause and occurrence of earthquakes; applications in seismic prospecting. Prerequisite: Phys. 285. *Professor Howell*

* Credits to be arranged, 1 to 6 per semester.
† Credits to be arranged, 3 to 6 per semester.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GEOPHYS. 401. GEOPHYSICAL PROSPECTING FOR ORES (3)
GEOPHYS. 402. PETROLEUM GEOPHYSICAL PROSPECTING (4) *Professor Howell*
GEOPHYS. 403. GEOPHYSICS FIELD WORK (1-3) Summer practicum.
GEOPHYS. 404. MINING GEOPHYSICS LABORATORY (1)
GEOPHYS. 405. INTRODUCTORY GEOPHYSICS (3) *Professor Howell*
GEOPHYS. 406. INTRODUCTORY GEOCHEMISTRY (3)

GERMAN

PROFESSOR PHILIP A. SHELLEY, A.M., Ph.D.
Head of the Department

GER. 501. GERMAN LANGUAGE SEMINAR (3-9) Critical study of special problems in the Germanic languages, with emphasis on Gothic and the High German dialects in different eras. Papers.

GER. 515. GERMAN LITERATURE SEMINAR (3-9) Special aspects and characteristics of individual writers and various types and periods of literature.

GER. 524. INTENSIVE STUDY OF THE LIFE AND WORKS OF GOETHE (3) Various phases of the poet's life and individual works. *Professor Buffington*

GER. 531. SPECIAL STUDIES IN THE GERMAN LYRIC (3) *Professor Shelley*

GER. 532. SPECIAL STUDIES IN THE GERMAN DRAMA (3) *Professor Adolf*

GER. 533. SPECIAL STUDIES IN THE GERMAN SHORT STORY (3) *Professor Steiner*

GER. 534. SPECIAL STUDIES IN THE GERMAN NOVEL (3) *Professor Adolf*

GER. 551. MIDDLE HIGH GERMAN (3) Extensive reading of texts; characteristics of the various dialects. *Professor Buffington*

GER. 552. OLD HIGH GERMAN (3) Essentials of the grammar, with special treatment of the High German sound shift and of ablaut and umlaut. Reading of works written before 1100 A. D. Papers. *Professor Buffington*

GER. 553. GOTHIC (3) Essentials of the grammar; reading of Ulfilas' Bible translation. Suitable also for advanced students in English. Papers. *Professor Adolf*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GER. 400. PROSEMINAR IN BIBLIOGRAPHY AND METHODS OF RESEARCH (2) *Professor Shelley*
GER. 401. HISTORY OF THE GERMAN LANGUAGE (3) *Professor Buffington*
GER. 421. GERMAN LITERATURE IN THE 18TH CENTURY (3) *Professor Buffington*
GER. 422. GERMAN LITERATURE IN THE 19TH CENTURY (3) *Professor Adolf*

GER. 423. GERMAN LITERATURE OF THE 20TH CENTURY (3) *Professor Steiner*
GER. 443. LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3-9) *Professor Shelley*

GREEK

PROFESSOR ROBERT E. DENGLER, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

GREEK 500. GREEK COMPOSITION (2) Translation of extended narrative passages into Attic Greek; a thorough review of forms and syntax; attention to the rhetorical elements of the language. *Professor Dengler*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

GREEK 411S. ESSENTIALS OF GREEK (3)
GREEK 421. GREEK TRAGEDY (3) *Professor Dengler*
GREEK 422. GREEK COMEDY (3) *Professor Dengler*
GREEK 423. ATTIC ORATORS (3) *Professor Dengler*
GREEK 424. GREEK HISTORY OR PHILOSOPHY (3) *Professor Dengler*
GREEK 427. NEW TESTAMENT GREEK (3) *Professor Dengler*

HEALTH EDUCATION

Consult PROFESSOR ARTHUR L. HARNETT, JR., M.A., Ed.D.

HEALTH ED. 501. HEALTH IMPLICATIONS IN THE GROWTH AND DEVELOPMENT OF SCHOOL CHILDREN (3) Child growth and development emphasis for teachers; medical inspection and examination; preschool program; early habit formations; behavior problems; co-operation of parents, teachers, and children. Prerequisite: Health Ed. 215. *Professor Davis*

HEALTH ED. 505. ADVANCED TECHNIQUES IN HEALTH EDUCATION (3) Prerequisites: Health Ed. 215, 399, Psy. 437. *Professor Harnett*

HEALTH ED. 572. TESTS AND MEASUREMENTS IN HEALTH EDUCATION (3) Critical study, evaluation, and demonstration of tests and measures of health education; statistical computations of data. Prerequisites: Phys. Ed. 490, Health Ed. 215, 399.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HEALTH ED. 403. FIRST AID, ATHLETIC CONDITIONING AND TRAINING (3) *Professor Fogg*

HEALTH ED. 405. RECENT DEVELOPMENTS IN PUUBLIC HEALTH EDUCATION (3-6) *Professor Davis*

HEALTH ED. 406. RECENT DEVELOPMENTS IN SCHOOL HEALTH EDUCATION (3) *Professor Davis*

HEALTH ED. 407, 407X. ADVANCED PERSONAL AND PUBLIC HEALTH (3) *Professor Harnett*

HEALTH ED. 411, 411X. SAFETY EDUCATION IN THE SCHOOLS (3) *Professor Werner*

HEALTH ED. 427. HEALTH FACTORS IN THE DEVELOPMENT OF THE ADOLESCENT (3) *Professor Davis*

HEALTH ED. 453, 453X. ORGANIZATION AND ADMINISTRATION OF HEALTH EDUCATION (3) *Professor Harnett*

HEALTH ED. 455S. RELATIONSHIPS OF HEALTH EDUCATION TO THE EXACT SCIENCES (3) *Professor Harnett*

HEALTH ED. 456. ADVANCED TECHNIQUES IN RURAL SCHOOL HEALTH (3) *Professor Davis*

HEALTH ED. 495S. FAMILY HEALTH AND HUMAN RELATIONS (3-9) *Professor Davis*

HISTORY

PROFESSOR ALFRED G. PUNDT, M.A., Ph.D.
Head of the Department

HIST. 500. SEMINAR IN AMERICAN HISTORY (3-6) Subject to be announced. *Professors Gray, Hermann, and Klein*

HIST. 501. EUROPEAN HISTORIOGRAPHY (3) *Professor Pundt*

HIST. 502. AMERICAN HISTORIOGRAPHY (3) *Professor Klein*

HIST. 506. THE DIPLOMATIC BACKGROUND OF THE WORLD WAR, 1871 TO 1914 (3) Prerequisites: Hist. 18, 19. *Professor Gillespie*

HIST. 507. THE REFORM MOVEMENT IN MODERN ENGLAND, 1832 TO THE PRESENT (3) *Professors Gillespie and Pundt*

HIST. 508. STUDIES IN EUROPEAN HISTORY, 1600-1789 (3)

HIST. 509. THE FRENCH REVOLUTION AND NAPOLEONIC ERA, 1789-1815 (3) Prerequisites: Hist. 18, 19. *Professor Gillespie*

HIST. 511. SEMINAR IN EUROPEAN HISTORY (3-6) *Professors Gillespie and Pundt*

HIST. 512. STUDIES IN PENNSYLVANIA HISTORY (3-6) *Professor Klein*

Hist. 515. Studies in Southern History (3) *Professor Klein*

Hist. 520. The American Revolution, 1763-1783 (3) Prerequisites: Hist. 20, 21. *Professor Hermann*

Hist. 529. Cultural History of the Early Middle Ages (3) *Professor Dahmus*

Hist. 532. Studies in Medieval Civilization (3) *Professor Dahmus*

Hist. 533. Studies in History of the United States, 1829-1860 (3) *Professor Klein*

Hist. 534. The Civil War and Reconstruction, 1860-1877 (3) Prerequisites: Hist. 20, 21. *Professors Klein and Hermann*

Hist. 536. Studies in the History of the United States, 1877-1900 (3)

Hist. 538. Studies in the History of Foreign Relations of the United States, 1492 to the Present (3)

Hist. 562. Seminar in Latin-American History (3-6) Prerequisites: Hist. 22, 23. *Professor Gray*

Hist. 563. Studies in the History of the Caribbean Area (3) Prerequisites: Hist. 22, 23. *Professor Gray*

Hist. 564. Mexico in the 20th Century (3) Prerequisites: Hist. 22, 23. *Professor Gray*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Hist. 405. Historical Background of American Political Parties, 1607-1900 (3) *Professor Rayback*

Hist. 406. History of American Labor (3) *Professor Rayback*

Hist. 407. The Diplomatic History of the United States (3) *Professor DeNovo*

Hist. 418. Renaissance and Reformation (3) *Professor Gillespie*

Hist. 419, 419X. Recent European History (3) *Professors Gillespie and Forster*

Hist. 421, 421X. Recent American History (3) *Professors Hermann and Forster*

Hist. 423. The Formative Period of American History (3) *Professor Klein*

Hist. 437. The Middle Ages from Constantine to the Crusades (3) *Professor Dahmus*

Hist. 438. The Middle Ages from the Crusades to the Renaissance (3) *Professor Dahmus*

Hist. 439. History of England to 1689 (3) *Professor Dahmus*

Hist. 440. History of Great Britain Since 1689 (3) *Professor Pundt*

Hist. 441. Recent History of Great Britain (3) *Professor Pundt*

Hist. 443. History of Modern Russia (3)

Hist. 444. Eastern Europe in Modern Times (3)

Hist. 446. The Development of the British Empire (3) *Professor Gillespie*

HIST. 447. ECONOMIC DEVELOPMENT OF MODERN EUROPE SINCE 1750 (3) *Professor Pundt*

HIST. 448. SOCIAL AND CULTURAL HISTORY OF MODERN EUROPE (3)

HIST. 450. ECONOMIC DEVELOPMENT OF COLONIAL AMERICA, 1607-1783 (3) To alternate with Hist. 451. *Professor Hermann*

HIST. 451. SOCIAL AND CULTURAL HISTORY OF COLONIAL AMERICA, 1607-1783 (3) To alternate with Hist. 450. *Professor Hermann*

HIST. 452. SOCIAL AND CULTURAL HISTORY OF THE UNITED STATES SINCE 1783 (3) *Professor Brown*

HIST. 453. AMERICAN POLITICAL BIOGRAPHY (3) *Professor Hermann*

HIST. 454. THE ECONOMIC DEVELOPMENT OF THE UNITED STATES IN THE 19TH CENTURY (3) *Professor McNall*

HIST. 460. LATIN AMERICA AND THE UNITED STATES (3) *Professor Gray*

HIST. 461. SOCIAL AND CULTURAL HISTORY OF LATIN AMERICA (3) To alternate with Hist. 460. *Professor Gray*

HIST. 499X. FOREIGN STUDY IN HISTORY (2-6)

HOME ART

MRS. BETH K. WHAM, M.S.

Acting Chairman of the Division

H. ART 500. RESEARCH IN HOME ART (1-6 per semester)

H. ART 501. THESIS (1-15)

H. ART 515. BACKGROUNDS OF THE HOME ARTS (3) Evaluation of useful objects in respect to their form, function, and time; selections for exhibition. Prerequisites: H. Art 216 or Art 54 or Art Ed. 6, and Art 74 or H. Art 240.

H. ART 541. ART IN THE ENVIRONMENT (3) Approach based upon human needs with consideration of materials in the light of their use in home living. Prerequisite: Art 76 or Art Ed. 5 or H. Art 440.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

H. ART 433, 433X. ADVANCED HOME CRAFTS (2-12)
H. ART 434. THE ART AND THE CRAFTS IN THE HOMEMAKING PROGRAM (3-6)
H. ART 440, 440X. HOME FURNISHING PROBLEMS (3)
H. ART 443. HOME ARTS IN THE ADULT PROGRAM (3)
H. ART 444, 444X. HOME FURNISHING TEACHING PROBLEMS (3)
H. ART 447, 447X. HOME FURNISHINGS FOR THE FAMILY (3)

HOME-COMMUNITY RELATIONSHIPS

Professor Helen R. LeBaron, M.S., Ph.D.
Chairman of the Division

H.C. Rel. 500. Research in Home-Community Relationships (1-6 per semester)

H.C. Rel. 501. Thesis (1-15)

H.C. Rel. 502, 502v, 502X, 502vX. Home Economics and American Society (3) Family life education in relation to a democratic culture; emphasis upon the interrelatedness of socioeconomic problems and the American family.

H.C. Rel. 503. Graduate Seminar in Home Economics (1) Prerequisite: graduate standing. *Professor Henderson*

HOME ECONOMICS EDUCATION

Professor Jean D. Amberson, M.A., Ph.D.
Head of the Department

H.E. Ed. 500, 500v. Research in Home Economics Education (1-6)
Professor Amberson or Hatcher

H.E. Ed. 501, 501v. Thesis (1-15)

H.E. Ed. 502, 502v. Home Economics Instruction at the College Level (3) Teaching techniques suitable for college instruction in home economics; for prospective home economics college teachers not majoring in home economics education.

H.E. Ed. 505, 505v, 505X, 505vX. Practicum in Teaching Home Economics in the Secondary School (3-6) Projects in home economics education which may be carried out in the school in which the teacher is regularly employed.
Professor Amberson

H.E. Ed. 506, 506v, 506X, 506vX. Current Developments in Education in Relation to Home Economics (3) Opportunity for home economists to study newer developments in education. Prerequisite: one year of teaching experience in home economics. *Professor Amberson*

H.E. Ed. 509, 509v, 509X, 509vX. Curriculum Workshop in Family Life Education (3) Laboratory course in problems of curriculum building; individual problems in this field; frequent individual and group conferences. Prerequisite: one year's experience in teaching home economics.
Professor Amberson or Hatcher

H.E. Ed. 510, 510v, 510X, 510vX. The Supervision of Home Economics Teaching (2-6) For teachers of home economics desiring to qualify as city, county, or

student teacher supervisors. Prerequisite: graduation from four-year teacher training curriculum and two years' teaching experience in home economics.
Professors Amberson, Hatcher, or Riegel

H.E. Ed. 518, 518v, 518X, 518vX. Evaluation in Family Life Education (3) Methods of evaluating progress toward goals in home economics education and the use of findings in program planning and revision. *Professor Hatcher*

H.E. Ed. 521, 521v, 521X, 521vX. Home Economics Education Seminar (2-3) Selected topics and recent developments in education for family living. Conferences and guidance relative to individual research problems.
Professor Amberson or Hatcher

H.E. Ed. 526, 526v, 526X, 526vX. The Community Program in Family Life Education (2-3) Ways of discovering community needs and resources; methods in developing the community program in family living; leadership education for the lay member of the community.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

H.E. Ed. 406, 406v, 406X, 406vX. Teaching Aids in Family Life Education (1-4)
Professor Riegel

H.E. Ed. 415v, 415vX. The Teaching of Homemaking (2)

H.E. Ed. 416v, 416vX. Administering the Homemaking Program (2)

H.E. Ed. 427, 427v, 427X, 427vX. Family Life Education (3)

H.E. Ed. 443, 443v, 443X, 443vX. Adult Homemaking Education (3)
Professor Cook

H.E. Ed. 463, 463v. Senior Seminar (1)

H.E. Ed. 466, 466v. Student Teaching (9)

H.E. Ed. 478, 478v, 478X, 478vX. Appraising Student Progress in Education for Family Living (3)

HORTICULTURE

Professor Warren B. Mack, M.S., Ph.D., Sc.D., A.N.A.
Head of the Department

Hort. 500. Ecology of Fruit Plants (3) The factors limiting the distribution and intensity of culture of fruit species and varieties and the effect of environmental factors on cultural practices.

Hort. 501. Pomology Research (2-12) Investigation of problems involving review of literature, field and laboratory research. Prerequisite or concurrent: Hort. 445. *Professor White*

Hort. 503. Experimental Plant Breeding (3-6) Problems based mainly on the research work of the department, with a review of experimental methods and literature. Prerequisite: Hort. 444. *Professor Larson*

HORT. 504. VEGETABLE CROP RESEARCH (2-9) Investigation of problems involving review of literature, field and laboratory research. Prerequisite: Hort. 420 or 424. *Professor Odland*

HORT. 505. PROBLEMS IN VEGETABLE PRODUCTION (2-6) Methods used in the more valuable contributions to vegetable production. Prerequisite: Hort. 420 or 424. *Professor Odland*

HORT. 506. NUTRITION OF HORTICULTURAL CROPS (2-4) Principles, applications, and interpretations of diagnostic methods for determining fertilizer requirements of horticultural crops. *Mr. Smith*

HORT. 507. PLANT BREEDING RESEARCH (3-6) A critical review of the breeding projects of the department, with original investigations. Prerequisite: Hort. 444. *Professor Larson*

HORT. 512. PRINCIPLES OF FRUIT AND VEGETABLE STORAGE (2-4) Principles involved in the maturation, storage, and senescence of fruits and vegetables, and their application. *Professor Mack*

HORT. 513. RESEARCH IN ORNAMENTAL HORTICULTURE (2-12) Review of research in ornamental horticulture, with original investigations. *Professor Meahl*

HORT. 514. PROPAGATION OF ORNAMENTAL AND FRUIT PLANTS (3) Factors affecting the asexual and sexual propagation of fruit and ornamental plants. *Professor Meahl*

HORT. 515. ECOLOGY OF ORNAMENTAL PLANTS (3) The interrelation of ornamental plants and their environments, with emphasis on autecology.

HORT. 517. HORTICULTURE SEMINAR (1 per semester) Review of current research publications in horticulture. Each student presents one or more reviews of assigned topics.

HORT. 518. RESEARCH PROBLEMS IN LANDSCAPE HORTICULTURE (2-12) Selected problems to be assigned for original investigation in the creation, conservation, or management of planted areas. Prerequisite: Hort. 455. *Professor Bracken*

HORT. 519. SEMINAR ON THE GENETICS OF HORTICULTURAL CROPS (1 per semester) Review of current research publications on the genetics of horticultural crops. Each student presents one or more reviews of literature on assigned topics.

HORT. 520. SEMINAR ON THE BREEDING OF HORTICULTURAL CROPS (1 per semester) Each student presents one or more reviews of literature on assigned topics.

HORT. 521. TECHNICAL PRACTICES IN LANDSCAPE CONTRACTING (2-12) Commercial and technical operations in landscape contracting and maintenance services. Prerequisites: Hort. 460, 461. *Professor Bracken*

HORT. 523. PROPAGATION AND IMPROVEMENT OF VEGETABLE AND FLOWER CROPS (3) Methods and special techniques in breeding of flowers and vegetables; maintenance of seed stocks and seed production. Prerequisite: Hort. 444 or Bot. 423. *Professor Odland*

HORT. 524. EXPERIMENTAL PROCEDURES IN HORTICULTURAL RESEARCH (3) *Professor Larson*

HORT. 525. HORTICULTURAL RESEARCH TECHNIQUES (3) Practice in and comparison of methods and apparatus used in horticultural research. *Professor White*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HORT. 418.	SUBTROPICAL AND TROPICAL FRUITS (3)	*Professor White*
HORT. 420.	ADVANCED COMMERCIAL VEGETABLE PRODUCTION (3)	*Professor Odland*
HORT. 423.	ADVANCED FRUIT AND VEGETABLE PROCESSING (3)	
HORT. 424.	ADVANCED OLERICULTURE (3-6)	*Professor Odland*
HORT. 427.	ADVANCED FLORICULTURE (3)	
HORT. 428.	ADVANCED FLORICULTURE (3)	
HORT. 444.	ADVANCED PLANT BREEDING (3-6)	*Professor Larson*
HORT. 445.	PRINCIPLES OF POMOLOGY (3)	*Professor White*
HORT. 446.	ADVANCED POMOLOGY (3)	*Professor White*
HORT. 447.	PROBLEMS IN POMOLOGY (1-3)	*Professor White*
HORT. 453.	NURSERY PRINCIPLES AND PRACTICE (3)	*Professor Meahl*
HORT. 454.	LANDSCAPE PROBLEMS (3-6)	*Professor Bracken*
HORT. 455.	LANDSCAPE PROBLEMS (3-6)	*Professor Bracken*
HORT. 456.	PROBLEMS IN NURSERY PRACTICE (3)	*Professor Meahl*
HORT. 460.	LANDSCAPE HORTICULTURE PROJECTS (3)	*Professor Bracken*
HORT. 461.	PARKS AND PARK ADMINISTRATION (3)	*Professor Bracken*
HORT. 462.	INSTITUTIONAL GROUNDS AND THEIR ADMINISTRATION (3)	*Professor Bracken*
HORT. 463.	LANDSCAPE HORTICULTURE PROJECTS (1-6)	*Professor Bracken*

HOTEL ADMINISTRATION

PROFESSOR ESTHER A. ATKINSON, M.S.
Head of the Department of Hotel and Institution Administration

The following courses may be taken for graduate credit under the restrictions in force:

HL. ADM. 440.	HOTEL OPERATIONAL LIABILITIES (2)	*Professor Bower*
HL. ADM. 445.	HOTEL ORGANIZATION AND OPERATION (3)	*Professor Bower*

HOUSING AND HOME EQUIPMENT

PROFESSOR DELPHA E. WIESENDANGER, M.S.
Acting Head of the Department of Home Management, Housing, and Art

HS. EQP. 500. RESEARCH IN HOUSING AND EQUIPMENT (1-6 per semester)

Hs. Eqp. 501. Thesis (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Hs. Eqp. 413. Home Equipment (3)
Hs. Eqp. 470, 470X. Housing the Family (2-3) *Professor Wiesendanger*

INDUSTRIAL ARTS

Professor S. Lewis Land, M.S., Ph.D.
Head of the Department of Industrial Education
Professor John F. Friese, M.S.

Ind. Arts 574. History and Philosophy of Industrial Arts (2-3) Historical developments and concurrent educational philosophies of industrial arts in American education. Prerequisite: 12 hours in professional courses in industrial arts education or teaching experience.

Ind. Arts 575. Problems in Industrial Arts Education (2-3) Subject matter, projects, methods of manual and informational teaching, aids and devices, selection of text and reference materials, personnel organization, shop management, problem pupils. Prerequisite: 12 hours of industrial arts education.

Ind. Arts 576. Supervision and Administration of Industrial Arts Education (2-3) How to organize, supervise, and administer functioning programs of industrial arts; the duties of a supervisor and director of industrial arts.

Ind. Arts 577. Testing in Industrial Arts (2-3) Construction of informal manipulative and written tests; use of standardized mechanical aptitude and achievement tests; construction and use of rating scales; scoring and grading; interpretation of test results. Prerequisites: 6 hours in graduate courses in industrial arts and a graduate course in psychology.

Ind. Arts 578. Research in Industrial Arts (1-18) Individual research in industrial arts for dissertations and lesser research studies. Prerequisite: 6 hours in professional courses in industrial arts.
Unit A. Common Research Techniques in Industrial Arts (2-3)
Unit B. Individual Research Problems in Industrial Arts (1-15)

Ind. Arts 579. Master's Thesis in Industrial Arts (1-6) Conferences and assignments relating to the preparation of an acceptable thesis for the Master of Science or Master of Education degrees. Prerequisite: 6 hours in professional courses in industrial arts.

Ind. Arts 580. Seminar in Industrial Arts (2-9) Directed intensive study, investigation, or research in selected phases of the program; reports and constructive criticism. Prerequisite: 12 hours in industrial arts education or teaching experience.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

IND. ARTS 407, 407X. INDUSTRIAL ARTS EDUCATION (2-3)
IND. ARTS 421, 421X. CURRICULUM MATERIALS IN INDUSTRIAL ARTS (2-3)
IND. ARTS 470, 470X. PROBLEMS IN SENIOR HIGH SCHOOL INDUSTRIAL ARTS (2-3)

INDUSTRIAL EDUCATION

PROFESSOR S. LEWIS LAND, M.S., Ph.D.
Head of the Department

IND. ED. 501v. SEMINAR IN VOCATIONAL EDUCATION (1-12) Conferences, investigations, and discussion for advanced students and mature persons who have had experience as teachers, supervisors, or administrators.
Unit A. Curriculum Construction (2-3)
Unit B. Testing and Grading (2-3)
Unit C. Vocational Technical Education (2-3)
Unit D. Adult Education (2-3)

IND. ED. 506v. ADMINISTRATION OF VOCATIONAL EDUCATION (1-6) The job of the local director of industrial education in organizing and developing city and other local programs of industrial education. Prerequisite: 6 semester hours in industrial education or valid director's certificate, equivalent training and experience.

IND. ED. 510v. VOCATIONAL EDUCATION FOR ADMINISTRATORS (2-3) Designed for school administrators and supervisors who desire an understanding of practical arts and vocational education. Prerequisite: Ind. Ed. 1v or trade or teaching experience.

IND. ED. 550v. RESEARCH IN VOCATIONAL EDUCATION (1-12) Research techniques in vocational education and research problems in connection with work of evening, part-time, or day vocational industrial schools.
Unit A. Research Techniques in Vocational Industrial Education (2-3)
Unit B. Individual Research Problems in Vocational Industrial Education (1-10)

IND. ED. 555v. CURRENT PROBLEMS IN VOCATIONAL EDUCATION (1-6) Recent trends and developments in part-time, full-time, and evening school education, involving critical analysis of objectives, content, and outcome.
Unit A. Changing Industrial, Economic, and Social Conditions (1)
Unit B. Policies and Program of the American Vocational Association (1)
Unit C. Federal and State Vocational Legislation, Present and Pending (1)
Unit D. Financing Vocational Education (1)
Unit E. Current Administrative Problems in Vocational Education (1)
Unit F. Current Administrative Problems in Vocational Education (continued) (1)

IND. ED. 558v. FRONTIER PROBLEMS IN VOCATIONAL INDUSTRIAL EDUCATION (2-3 per unit)

Unit A. Federal Legislation (2-3)
Unit B. Present-Day Local Personnel and Curriculum Problems (2-3)
Unit C. State and Local Supervision and Administration (2-3)

IND. ED. 560v. PHILOSOPHY OF INDUSTRIAL EDUCATION (2-3) Principles and beliefs upon which progressive industrial education rests; basic concepts underlying practical arts and vocational education; literature for evaluating instructional practices. Prerequisite: 12 hours in industrial education or teaching experience.

IND. ED. 590v. MASTER'S THESIS IN INDUSTRIAL EDUCATION (2-6) Conferences and assignments relating to the selection and preparation of an acceptable thesis for the degree of Master of Education or Master of Science.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

IND. ED. 401v, 401vX. HISTORY OF INDUSTRIAL EDUCATION (2-3)
IND. ED. 402v, 402vX. SUPERVISION OF VOCATIONAL EDUCATION (2-3)
IND. ED. 403v, 403vX. SUPERVISED FIELD WORK (1-6)
IND. ED. 405v, 405vX. CONFERENCE LEADER TRAINING (2-3)
IND. ED. 408v, 408vX. OCCUPATIONS (2-3)
IND. ED. 409v, 409vX. TESTS AND MEASUREMENTS (2-3)
IND. ED. 410v, 410vX. INFLUENCES OF MODERN INDUSTRIAL LIFE ON INDUSTRIAL EDUCATION (2-3)
IND. ED. 412v, 412vX. SPECIAL PROBLEMS IN VOCATIONAL EDUCATION (2-4)
IND. ED. 414v, 414vX. VOCATIONAL EDUCATIONAL GUIDANCE (2-3)
IND. ED. 415v, 415vX. PROBLEMS IN CO-ORDINATING VOCATIONAL EDUCATION (2-3)
IND. ED. 418v, 418vX. PROBLEMS IN AUDIO-VISUAL AIDS IN INDUSTRIAL EDUCATION (2-3)
IND. ED. 420v, 420vX. OCCUPATIONAL HYGIENE (2-3)
IND. ED. 425v, 425vX. WORKSHOP IN INDUSTRIAL EDUCATION (1-6)
IND. ED. 427v, 427vX. ADVANCED COURSE OF STUDY BUILDING (2-3)
IND. ED. 430v, 430vX. SAFETY EDUCATION FOR VOCATIONAL TEACHERS (2-3)
IND. ED. 436v, 436vX. ADULT EDUCATION IN INDUSTRIAL AMERICA (2-3)
IND. ED. 446v, 446vX. IMPROVEMENT OF INSTRUCTION IN VOCATIONAL EDUCATION (2-4)
IND. ED. 450v, 450vX. SHOP LAYOUT AND MANAGEMENT (2-3)
IND. ED. 458v. EMERGING PROBLEMS IN VOCATIONAL EDUCATION (1-7)
Unit A. Federal and State Laws Relating to Vocational Education (1)
Unit B. Framework of Federal, State, and Local Administrative Agencies (1)
Unit C. Federal, State, and Local Policies and Plans for Vocational Education (1)
Unit D. Local Administration of Vocational Education (1)
Unit E. Labor Laws and Labor Relations Affecting Education (1)
Unit F. Vocational Training for War and Postwar Eras (1)
Unit G. Problems in Vocational Rehabilitation of the Physically Handicapped (1)

IND. ED. 460. PROBLEMS IN VOCATIONAL REHABILITATION OF THE HANDICAPPED (1-6)
Unit A. The Counseling Interview in Vocational Rehabilitation (1-3)
Unit B. Occupational Information and Placement Techniques in Vocational Rehabilitation (1-3)

INDUSTRIAL ENGINEERING

PROFESSOR CLARENCE E. BULLINGER, I.E., M.S.
Head of the Department

I.E. 501. MANUFACTURING METHODS (2-8) Special projects including investigation; experimentation, design, and research of some one or more special types of manufacture. *Professor Bullinger*

I.E. 502. MANAGEMENT METHODS (3-6) Intensive study of the newer phases of scientific management, including production control and application of Gantt charts; research on special problems. *Professor Bullinger*

I.E. 503. PERSONNEL RELATIONS (2-8) Research on special topics. *Professor Bullinger*

I.E. 505. GRAPHICAL COMPUTATION (2-10) The construction of natural and logarithmic scales, applications of various co-ordinate papers and construction of nomographic or alignment charts; determination of empirical formulae from engineering data. *Professor Babcock*

I.E. 506. TIME AND MOTION STUDY (3-9) Machine data, elementary and fundamental machine times; determination of fatigue curves; design of Barth slide rules, micromotion study and chart plotting of micromotion results; chronocyclegraph study. *Professor Anderson*

I.E. 507. BUDGETARY CONTROL AND STANDARD COSTS (3-6) Divisional budgets as control media; establishing standard cost data, standard cost accounting procedures, and the use of cost variances in controlling manufacturing operations. Prerequisite: I.E. 401. *Professor Hussey*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

I.E. 401. INDUSTRIAL ACCOUNTS (4) *Professor Hussey*
I.E. 404. SCIENTIFIC MANAGEMENT (2) *Professor Bullinger*
I.E. 406. FACTORY PLANNING (2) *Professor Babcock*
I.E. 409. PERSONNEL ADMINISTRATION (3) *Professor Thomas*
I.E. 411. MANUFACTURING BUDGETS (2) *Professor Hussey*
I.E. 422a,b,c,d,e,f. INDUSTRIAL ENGINEERING PROBLEMS (2 per unit)
Professors Babcock, Bullinger, Anderson, Hussey, and Thomas
I.E. 423. QUALITY CONTROL (2-3) *Professor Bullinger*
I.E. 424. JOB EVALUATION (3) *Professor Thomas*

INSTITUTION ADMINISTRATION

Professor Esther A. Atkinson, M.S.
Head of the Department of Hotel and Institution Administration

In. Adm. 500. Research in Institution Administration (1-6 per semester)

In. Adm. 501. Thesis (1-15)

In. Adm. 502. Problems in Institutional Administration (3-6) Individual study of problems in institutional administration. Prerequisites: In. Adm. 306, 330, 426.
Professor Atkinson

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

In. Adm. 410. Tea Room Management (3)
In. Adm. 437a,b,cS. School Cafeteria Problems (1-3) Units A, B, C, 1 credit per unit.
In. Adm. 438. School Cafeteria (2-4)
In. Adm. 461. Institution Administration (3)
In. Adm. 462. Institution Experience (3)

ITALIAN

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

It. 571. Seminar in Italian Literature (3) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

JOURNALISM

Professor Franklin C. Banner, M.A.
Head of the Department

The following course may be taken for graduate credit under the restrictions in force:

Journ. 430S. Supervision and Management of School Publications (3)

LATIN

Professor Robert E. Dengler, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

Latin 500. Latin Literature (3) Lectures and collateral readings on the major forms of Latin literature; readings in the original Latin to supplement the lectures. *Professor Dengler*

Latin 501. Roman Religion and Philosophy (3) Development of religious concepts at Rome from primitive Italic origins to the advanced form that culminated in Roman Stoicism. *Professor Krauss*

Latin 502. Latin Epigraphy (3) Lectures and readings on Roman inscriptions; illustrative exercises. *Professor Krauss*

Latin 503. Latin Paleography (3) The Latin alphabet, writing materials, Roman book and cursive hands; illustrative exercises. *Professor Dengler*

Latin 504. Roman Topography (3) The physical development of the city of Rome, its walls, aqueducts, bridges, streets, fora, public buildings, temples, etc.; building materials and methods of construction. *Professor Krauss*

Latin 510. Latin Seminar (3)

Latin 518. Latin Research (1-3) Prosecution of an assigned problem under the guidance of a member of the department. *Professor Dengler*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Latin 428. Lucretius (3) *Professor Krauss*
Latin 429. Quintilian (3) *Professor Krauss*
Latin 431. Juvenal (3) *Professor Krauss*
Latin 436S. Functional Problems in Latin (3)
Latin 440a,b,c,dS. College Latin (3-12) *Professor Dengler*

LIBRARY SCIENCE

Consult Librarian Ralph W. McComb, M.A.

The following courses may be taken for graduate credit under the restrictions in force:

Lib. Sci. 403S. Intermediate Dictionary Cataloging and Subject Headings (2-3)
Lib. Sci. 405S. Intermediate Reference Work and Bibliography (2-3)

MATHEMATICS

Professor Orrin Frink, Jr., M.A., Ph.D.
Head of the Department

Math. 500. Analytical Mechanics (3) An exposition of rigid dynamics, the potential function, and Lagrange's equations. Prerequisite: Math. 419.

Math. 501. Theory of Functions of a Real Variable (3) Theory of real functions, sets, measure, derivatives, and integrals. Prerequisite: Math. 420.

Math. 502. Theory of Functions of a Real Variable (3) Continuation of Math. 501.

Math. 503. Fourier Series and Harmonic Functions (3) Fourier series and integrals; spherical harmonics, Bessel functions, etc., with special emphasis on their applications. Prerequisites: Math. 90, 420.

Math. 505. Integral Equations (3) Fredholm and Volterra equations, and applications. Prerequisite: Math. 421.

Math. 507. Calculus of Variations (3) Prerequisites: Math. 90, 421.

Math. 508. Theory of Functions of a Complex Variable (3) Development of the complex number system; theory of analytic functions. Prerequisite: Math. 421.

Math. 509. Theory of Functions of a Complex Variable (3) Continuation of Math. 508.

Math. 510. Theory of Groups (3) General properties of groups with applications. Prerequisite: mathematical maturity.

Math. 511. Introduction to Higher Algebra (3) Algebra of matrices, determinants, bilinear and quadratic forms. Prerequisites: Math. 9, 11.

Math. 512. Introduction to Higher Algebra (3) Continuation of Math. 511.

Math. 513. Advanced Analytic Geometry (3) Introduction of homogeneous coordinates and their use in the study of projective properties. Prerequisite: Math. 30.

Math. 514. Advanced Analytic Geometry (3) Continuation of Math. 513.

Math. 520. Projective Geometry (3) A general study of the subject from the postulational standpoint. Prerequisite: Math. 30. Alternate years or as required.

Math. 521. Projective Geometry (3) Continuation of Math. 520.

Math. 522. Metric Differential Geometry (3) The usual classical treatment of the subject. Prerequisite: Math. 11 or 30.

Math. 523. Differential Geometry (3) Continuation of Math. 522.

MATH. 524. PROJECTIVE DIFFERENTIAL GEOMETRY (3) Study of the classic methods of Wilcznski, Lane, Fubini, etc. Prerequisite: Math. 514.

MATH. 525. PROJECTIVE DIFFERENTIAL GEOMETRY (3) Continuation of Math. 524.

MATH. 526. ALGEBRAIC GEOMETRY (3) Involutions on rational curves and related topics. Prerequisite: Math. 514.

MATH. 527. ALGEBRAIC GEOMETRY (3) Continuation of Math. 526.

MATH. 530. TOPOLOGY (3) Topological spaces, combinatorial topology, applications to algebra and analysis. Prerequisite: mathematical maturity.

MATH. 531. TOPOLOGY (3) Continuation of Math. 530.

MATH. 532. THEORY OF SETS (3) Theory of abstract sets; cardinal and ordinal numbers; sets of points in Euclidean space and in general metric space; theory of measure with applications to geometry and function theory. Prerequisite: general mathematical maturity.

MATH. 533. THEORY OF SETS (3) Continuation of Math. 532. Prerequisite: Math. 532.

MATH. 534. THEORY OF ALGEBRAIC NUMBERS (3) An introduction to the number theory of quadratic fields, with a study of the theory of ideals in quadratic and higher fields, with application. Prerequisite: Math. 404.

MATH. 535. MODERN ALGEBRAIC THEORIES (3) Algebraic invariants, matrices, quadratic and Hermitian forms, Galois theory of equations, modular systems, etc. Prerequisite: general mathematical maturity.

MATH. 536. MODERN ALGEBRAIC THEORIES (3) Continuation of Math. 535.

MATH. 540. THEORY OF RELATIVITY (3) An introduction to the subject by a study of the Riemann Einstein space. Prerequisites: Math. 405, 417, 431.

MATH. 541. THEORY OF RELATIVITY (3) Continuation of Math. 540.

MATH. 550. MATHEMATICAL LOGIC (3) The logical basis of mathematics and its ultimate nature. Prerequisite: general mathematical maturity.

MATH. 552. NUMERICAL METHODS (3) Procedures for practical calculation, including interpolation, solution of equations, iterative methods, harmonic analysis, and use of modern calculating equipment. Prerequisite: Math. 420.

MATH. 553. NUMERICAL METHODS (3) Continuation of Math. 552. Prerequisite: Math. 552.

MATH. 560. THEORY OF DIFFERENTIAL EQUATIONS (3) Prerequisites: Math. 90, 421.

MATH. 561. THEORY OF DIFFERENTIAL EQUATIONS (3) Continuation of Math. 560.

MATH. 570. SPECIAL TOPICS IN GEOMETRY (3-6)

MATH. 571. SPECIAL TOPICS IN ANALYSIS (3-6)

MATH. 572. SPECIAL TOPICS IN ALGEBRA (3-6)

MATH. 573. SPECIAL TOPICS IN APPLIED MATHEMATICS (3-6)

MATH. 575. MATHEMATICS SEMINAR (2-6) Selected topics from recent mathematical developments. Prerequisite: general mathematical maturity.

MATH. 576. MATHEMATICS SEMINAR (2-6) Continuation of Math. 575.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MATH. 403. MODERN METHODS IN GEOMETRY (3)
MATH. 404. THEORY OF NUMBERS (3)
MATH. 405. PARTIAL DIFFERENTIAL EQUATIONS (3)
MATH. 409. THEORY OF PROBABILITY (3)
MATH. 410. STATISTICAL METHODS (3)
MATH. 411. FINITE DIFFERENCES (3)
MATH. 417. VECTOR ANALYSIS (3)
MATH. 419. ANALYTICAL MECHANICS (3)
MATH. 420. ADVANCED CALCULUS (3)
MATH. 421. ADVANCED CALCULUS (3)
MATH. 424. LEAST SQUARES (2)
MATH. 425. CURVE FITTING (1)
MATH. 431. DIFFERENTIAL EQUATIONS (3)
MATH. 440. THEORY OF EQUATIONS (3)
MATH. 441. THEORY OF EQUATIONS (3)
MATH. 451. INTRODUCTION TO APPLIED MATHEMATICS (3-6)
MATH. 452. INTRODUCTION TO APPLIED MATHEMATICS (3-6)
MATH. 471. FOUNDATIONS OF ALGEBRA (3)
MATH. 472. FOUNDATIONS OF GEOMETRY (3)

MECHANICAL ENGINEERING

PROFESSOR NORMAN R. SPARKS, M.E.
Head of the Department

M.E. 502. ADVANCED GAS TURBINES (3-6) The thermodynamic and stress analysis design of gas turbine and compressor units. Prerequisite: M.E. 409.

M.E. 504. ADVANCED THERMODYNAMICS (3-6) Pure and applied thermodynamics including its application to advanced engineering problems; collateral reading and discussion of the classical works on the subject. Prerequisite: M.E. 3 or 104.

M.E. 505. HEAT TRANSMISSION (3-6) Applications of principles of heat transfer to efficient design of mechanical engineering equipment. Prerequisite: M.E. 412.

M.E. 506. MECHANICAL ENGINEERING SEMINAR (1-4) Advanced courses adapted to the individual requirements of graduates in mechanical engineering.

M.E. 507. Advanced Internal Combustion Engines (3) Design and performance of both carburetor and fuel injection type reciprocating engines primarily from the thermodynamic viewpoint, with emphasis on the economics of operation. Prerequisites: M.E. 413, 504.

M.E. 508. Mechanical Engineering Research (1-9) Research related to the mechanical engineering major subject; work must show evidence of original thinking; may be scheduled as thesis work for the M.S. degree.

M.E. 509. Heat Engineering Seminar (2-6) Advanced studies in design and performance of heat equipment, direct-fired and unfired; adapted to the individual requirements of graduates in mechanical engineering. Prerequisite: M.E. 6.

M.E. Des. 502. Friction and Lubrication (3) The hydrodynamic theory of lubrication, and the methods of applying it to bearing design, together with a survey of methods of testing lubricants.

M.E. Des. 505. Advanced Dynamics of Machines (3-6) Linear and torsional vibrations in and balancing of rotating and reciprocating machinery; an exact analysis of the stresses produced by these and other dynamic forces in machine parts. Prerequisites: Mchs. 12, M.E. Des. 8.

M.E. Lab. 501. Investigation Projects (2-6) Special experimental studies or investigations in mechanical engineering, adapted to individual requirements.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

M.E. 401a,b,c,d. Mechanical Engineering (3-12)
M.E. 402. Air Conditioning (3)
M.E. 408. Steam Turbines (3)
M.E. 409. Gas Turbines (3)
M.E. 410. Steam Power Plants (3)
M.E. 411. Refrigeration (3)
M.E. 412. Fundamentals of Heat Transfer (3)
M.E. 413. Internal Combustion Engines (3)
M.E. 416. Resistance and Powering of Ships (3)
M.E. Des. 402. Design of Machine Tools (3)
M.E. Des. 403. Advanced Machine Design Problems (3)
M.E. Des. 404. Machine Design Analysis (3)

METALLURGY

Professor Jay W. Fredrickson, Ph.D.
Chief of the Division

Met. 500. Metallurgical Research (3-15 per semester) Research on special topics; conferences, reading, and library work. Results may be embodied in a thesis. Prerequisites: Met. 411, 413.

MET. 501. METALLURGICAL PROBLEMS (1-6 per semester) Independent study of special problems in metallurgy. Prerequisites: Met. 411, 413.

MET. 502. METALLURGICAL SEMINAR (1 per semester) Conferences, reading, and reports. Required of all graduate students in metallurgy.

MET. 515. CORROSION AND PROTECTION OF METALLIC SURFACES (3) Phenomena and theories of metallic corrosion; chemistry and metallurgy of metal protection. Prerequisites: Met. 411, 413. *Professor Read*

MET. 516. MECHANICAL METALLURGY (3) Theories of plastic flow in polycrystalline metals; calculations of simple and combined stresses and application to metal forming and mechanical tests. Prerequisites: Met. 411, 413.

MET. 517. ADVANCED NONFERROUS METALLURGY (3) Theory of electrorefining, electrowinning, and processes involving the vapor phase; physical chemistry of roasting and leaching. Prerequisites: Met. 411, 413. *Professor Read*

MET. 518. CONSTITUTION OF METALLURGICAL SYSTEMS (3) Application of thermodynamic principles to study of heterogeneous equilibrium in alloy, slag, and slag-metal systems. Prerequisites: Met. 411, 413. *Professor Davis*

MET. 519. ADVANCED FERROUS METALLURGY (3) Physicochemical principles in the smelting and refining of iron and steel; slag control; solidification and primary forging of steel. Prerequisites: Met. 411, 413. *Professor Davis*

MET. 520. FOUNDRY METALLURGY (3) Principles of foundry metallurgy; application to foundry operations for various ferrous and nonferrous casting alloys. Prerequisites: Met. 411, 413. *Professor Lindsay*

MET. 521. ENGINEERING ALLOYS (3) Requirements and applications of industrial alloys: mechanical, thermal, electrical, and magnetic properties. Prerequisites: Met. 411, 413. *Professor Lindsay*

MET. 522. SOLID PHASE REACTIONS IN METALS (3) Mechanism and rate determining factors in solid phase reactions in metals; diffusion processes, nucleation theory, precipitation from solid solution, eutectoid, decomposition and order-disorder phenomena. Prerequisites: Met. 411, 413. *Professor Lindsay*

MET. 523. BEHAVIOR OF METAL CRYSTALS (3) Plastic action in single crystals of metals and in polycrystalline metals, theoretical crystal plasticity, recovery, and recrystallization, deformation and recrystallization textures, anistropy in general. Prerequisites: Met. 411, 413. *Professor Fredrickson*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MET. 405. FERROUS METALLOGRAPHY (3)
MET. 406. NONFERROUS METALLOGRAPHY (3)
MET. 407. METALLURGICAL ENGINEERING I (3)
MET. 408. METALLURGICAL ENGINEERING II (3)
MET. 409. METALLURGICAL INVESTIGATIONS I (3)

MET. 410. METALLURGICAL INVESTIGATIONS II (3)
MET. 411. ADVANCED PHYSICAL METALLURGY (3)
MET. 412. EXPERIMENTAL METALLURGY (3)
MET. 413. ADVANCED CHEMICAL METALLURGY (3)

METEOROLOGY

PROFESSOR HANS NEUBERGER, D.Sc.
Chief of the Division

METEOR. 500. METEOROLOGICAL SEMINAR (1-3) Discussion of meteorological reports and papers; scientific outlook. Prerequisites: Meteor. 421, 441, 451.

METEOR. 501. METEOROLOGICAL RESEARCH (3-15) Research work in physical, synoptic, dynamic meteorology; climatology. Prerequisites: a minimum of one year of physics, calculus, and differential equations, 15 credits in meteorology.

METEOR. 502. SELECTED TOPICS OF ADVANCED METEOROLGY (2) Lectures, review, and discussion of current problems in meteorology. Prerequisite: a minimum of 15 credits in meteorology.

METEOR. 504. THEORETICAL AND DYNAMIC METEOROLOGY (3) Mathematical analysis of meteorological phenomena; theory of circulation; deformation fields. Prerequisite: Meteor. 452.

METEOR. 505. BIOCLIMATOLOGY (2) Climatic phenomena in their relation to life. Prerequisite: Meteor. 372.

METEOR. 506. ADVANCED METEOROLOGICAL ANALYSIS (2-6) Physical analysis of atmospheric phenomena; synoptic analysis of weather phenomena for advanced students. Prerequisite: Meteor. 421.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

METEOR. 421. SYNOPTIC METEOROLOGY I (3)
METEOR. 422. SYNOPTIC METEOROLOGY II (3)
METEOR. 431. SYNOPTIC METEOROLOGY LABORATORY I (2)
METEOR. 432. SYNOPTIC METEOROLOGY LABORATORY II (2-10)
METEOR. 441. PHYSICAL METEOROLOGY I (2)
METEOR. 442. PHYSICAL METEOROLOGY II (2)
METEOR. 451. DYNAMIC METEOROLOGY I (3)
METEOR. 452. DYNAMIC METEOROLOGY II (3)
METEOR. 453. PROBLEMS IN DYNAMIC METEOROLOGY (1)
METEOR. 492. METEOROLOGICAL SEMINAR (2)

MINERAL ECONOMICS

Professor W. M. Myers, M.S., Ph.D.
Chief of the Division

Min. Econ. 500. Marketing of Minerals and Mineral Products (3-6) Research in mineral marketing problems. Prerequisite: Min. Econ. 453. *Professor Myers*

Min. Econ. 501. Research in Mineral Economics (3-6) Investigation in specialized fields of research in mineral economies. Prerequisite: Min. Econ. 453. *Professor Myers*

Min. Econ. 502. Technologic Influences (3-9) The relationship of technologic advancements to the financial development of the mineral industries. Prerequisites: Min. Econ. 87, 483.

Min. Econ. 503. Seminar (2 per semester) Prerequisite: Min. Econ. 400.

Min. Econ. 504. Valuation of Mineral Properties and Equities (3-6) Techniques involved in the valuation of mineral deposits and the equities of operating companies. Prerequisite: Min. Econ. 490.

Min. Econ. 505. Problems of Mineral Economics (3-12) The determination of basic technologic-economic patterns of selected mineral industries. Prerequisite: Min. Econ. 87.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Min. Econ. 400. Seminar (1) *Professor Myers*
Min. Econ. 453. Nonmetallic Minerals (3) *Professor Myers*
Min. Econ. 483. The Metals and Their Ores (3) *Professor Myers*
Min. Econ. 484. The Solid Fuels (3) *Professor Myers*
Min. Econ. 486. Petroleum and Natural Gas Economics (3)
Min. Econ. 490. Mineral Valuation (3)

MINERAL PREPARATION

Professor H. Beecher Charmbury, M.S., Ph.D.
Chief of the Division

Min. Prep. 502. Froth Flotation and Agglomeration (3) An intensive study of the theory and applications of froth flotation and agglomeration. Prerequisite: Min. Prep. 405. *Professor Sun*

Min. Prep. 504. Mineral Preparation Research (3-10) Research work on specific problems in mineral preparation. Prerequisite: Min. Prep. 405 or 410.

Min. Prep. 505. Gravity Processes and Miscellaneous Methods of Mineral Preparation (3) An intensive study of the theory and applications of gravity,

magnetic, electrostatic, centrifugal, and dense-media processes of mineral concentration. Prerequisite: Min. Prep. 405.

MIN. PREP. 506. MINERAL PREPARATION PLANT DESIGN (3-10) The layout, design, and selection of equipment for specific mineral preparation plant projects. Prerequisite: Min. Prep. 405.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MIN. PREP. 400. MINERAL PREPARATION SEMINAR (1)
MIN. PREP. 403. FLOWSHEETS OF MINERAL PREPARATION PLANTS (2)
MIN. PREP. 404. PLANT LAYOUT AND DESIGN (3)
MIN. PREP. 405. UNIT OPERATIONS (3)
MIN. PREP. 406. MINERAL PREPARATION TESTING (2)
MIN. PREP. 410. COAL PREPARATION (3)

MINERALOGY

PROFESSOR PAUL D. KRYNINE, PH.D.
Chief of the Division

MIN. 500. PHYSICAL MINERALOGY (3) Optical methods and measurement of optical constants of minerals. *Professors Krynine and Bates*

MIN. 501a. PETROLOGY (3-6) Microscopic study of rocks, emphasizing classification and genetic relationships. *Professors Krynine, Osborn, and Griffiths*

*MIN. 502a. MINERALOGICAL RESEARCH (3-18) An original study of some mineralogical problems, results of which may be applied on the thesis requirements.

MIN. 504. THEORETICAL MINERALOGY (2) Selected topics in crystal chemistry and crystal physics applied to solid solution, polymorphism, crystal growth, and related phenomena; laboratory studies of identification techniques including X-ray diffraction. Prerequisite: Min. 461. *Professor Bates*

†MIN. 505. MINERALOGY SEMINAR (1-2) Reading, presentation, and discussion of literature dealing with various phases of theoretical mineralogy. Topics are selected to meet the interests of the majority of the students.
Professors Krynine, Osborn, Bates, and Griffiths

‡MIN. 507. PHYSICOCHEMICAL PETROGRAPHY (3) Advanced work in the constitution and phase relations of inorganic crystals and liquids; special emphasis on silicate compounds and glasses. Prerequisite: Min. 483. *Professor Osborn*

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* Credits to be arranged, 3-9 per semester.
† Credits to be arranged, 1 per semester.
‡ Credits to be arranged, 1-3 per semester.

‡Min. 508. Physicochemical Petrology (3) Application of the principles of physicochemical petrography to the origin of igneous and metamorphic rocks; the distribution of elements in the earth's crust. Prerequisite: Min. 507.
Professor Osborn

§Min. 510. Metamorphism (2-6) A detailed review of chemical mineralogical and structural changes that take place during metamorphism. Prerequisite: Min. 483. *Professors Krynine, Osborn, Bates, and Griffiths*

‖Min. 511. Basic Sedimentology (3-4) Composition, texture, structure, mass properties of sediments; dynamic processes in complex natural systems; sedimentary stages: weathering, erosion, transport, deposition, and lithification. Prerequisite: Min. 483. Concurrent: Min. 513. *Professor Krynine*

‖Min. 512. Basic Sedimentology, Continued (3-4) Diastrophism and tectonic background of sedimentation; depositional loci; classification of sediments: the quartzites, graywackes, and arkoses; chemical sediments; paleogeography, paleoclimatology, oil finding. Prerequisite: Min. 511. Concurrent: Min. 514.
Professor Krynine

Min. 513. Methods of Analysis of Sediments (2) Principles and practices used in analyzing sedimentary rocks for size, shape, and accessory (heavy) minerals. Concurrent: Min. 511. *Professor Griffiths*

Min. 514. Applied Sedimentology (2) Design and control in analysis of sedimentary rocks; application of these techniques to industrial problems. Concurrent: Min. 512. *Professor Griffiths*

Min. 515. Mineralogy of Clays and Other Fine-Grained Materials (2-3) The physical and chemical properties of clay minerals; importance and application of X-ray diffraction, differential thermal analysis, light and electron microscopy. Prerequisite: Min. 460. *Professors Bates and Griffiths*

¶Min. 516. Petrology of Fine-Grained Sediments (2-3) The fine-grained sedimentary rocks and their industrial applications. Prerequisite: Min. 515.
Professors Griffiths and Bates

‡Min. 517. European Sediments (1-6) Interpretative microscopic and hand specimen study of selected rock suites from Europe and Asia; correlation with paleogeographic and tectonic data. Prerequisites: Min. 512, 514. *Professor Krynine*

§Min. 518. American Sediments (2-8) Thin section, heavy residue, textural and field data of arkoses, graywackes, quartzites, and carbonates from representative North American sedimentary provinces. Prerequisites: Min. 512, 514, 516.
Professor Krynine

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‡ Credits to be arranged, 1-3 per semester.
§ Credits to be arranged, 2-4 per semester.
‖ Credits to be arranged, 3-4 per semester.
¶ Credits to be arranged, 2-3 per semester.

¶Min. 519. Oil Reservoir Petrology (2-6) The petrographic fundamentals controlling porosity, storage capacity, oil accumulation, effective permeability, fluid yield and retention, exploration and production methods. Prerequisites: Min. 512, 514, 516. *Professors Krynine and Griffiths*

§Min. 520. Study of Accessory Minerals (2-4) Detailed study of accessory (heavy) minerals; their significance in problems of provenance, petrogenesis, mineral stratigraphy, and paleogeography. Prerequisites: Min. 511, 512, 513, 514. *Professor Griffiths*

Min. 521. Color in Minerals (1-2) The nature of light absorption as a function of chemical composition for solutions, glasses, and minerals. *Professor Weyl*

¶Min. 522. The Electron Microscope in Mineralogical and Geological Problems (2-6) Laboratory investigation of geological subjects at high magnification; correlation of data with those obtained by other methods of study. *Professor Bates*

¶Min. 523. X-Ray Diffraction Studies of Minerals (2-6) Investigation of mineralogical problems with X-rays. Practicum includes preparation of samples, use of X-ray apparatus, and interpretation of patterns. Prerequisite: Min. 461. *Professor Bates*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Min. 460. Physical Mineralogy (3) *Professor Bates*
Min. 461. Descriptive Mineralogy (4) *Professor Bates*
Min. 483. Petrography (4) *Professor Griffiths*

MINING

Professor Arnold W. Asman, B.Sc.
Chief of the Division

Mng. 500. Mining Seminar (2) Conferences, reading, and reports. Scientific management; public relations; technological developments. Required of all graduate students in mining engineering.

Mng. 501. Mine Engineering (3) Mine mechanization problems. The selection of the most suitable equipment for various conditions. Prerequisite: Mng. 488.

Mng. 504. Mining Research (3-10 per semester) Research work on specific problems in physics of mining and mine mechanization. Prerequisite: Mng. 481.

Mng. 506. Mine and Mine Plant Design (3-10) The layout, design, and selection of equipment for specific mining and mine plant projects. Prerequisite: Mng. 499.

§ Credits to be arranged, 2-4 per semester.
¶ Credits to be arranged, 2-3 per semester.

Mng. 520. Mine Planning Using Cycle Studies (3-6) Highly productive cycles of mine section operation are developed by use of time and method studies of the various sub-cycles involved. Prerequisite: Mng. 72.

Mng. 521. Mathematical Analysis of Mine Layouts (3) Proportioning layouts in regard to mineral available, distances, and centroids of mining areas; incremental and sub-cycle costs. Prerequisite: Mng. 488.

Mng. 522. Rock Mechanics (3-6) A detailed study of the physical properties of rocks as affecting the design of underground openings; testing procedures, calculations, and design. Prerequisite: Mng. 499.

Mng. 523. Mine Dusts (3) Detailed studies of methods of collecting, sampling, and determining the amount, size, and mineral content of dust in mine atmospheres; methods of dust control. Prerequisite: Mng. 481.

Mng. 524. Underground Mining Power Distribution Systems (3-6) Calculations involved in the design of power applications and systems for mines; electrical, compressed air; Diesels; package power for extremely gassy conditions; sectionalizing; loads and load centers. Prerequisite: Mng. 488.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Mng. 400. Mine Safety Engineering (2)
Mng. 481. Physics of Mining (4)
Mng. 484. Mine Cost Control (2)
Mng. 488. Advanced Mine Mechanization (3)
Mng. 494. Mine Management Engineering (3)
Mng. 499. Advanced Mining Design (2)

MUSIC

Professor Hummel Fishburn, M.A., Mus.D.
Head of the Department

Music 503-506. Advanced Stringed Instruments (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 103-106. Fee $25 per course.
Professor Karhan

Music 511-514. Advanced Piano (3 per course) Piano literature of all periods; stress laid on developing technique and preparing for public performance. Fee $25 per course. *Professor Brinsmaid*

Music 531-534. Advanced Organ (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 31-34. Fee $30 per course.
Professor Ceiga

MUSIC 558-561. FREE COMPOSITION (3 per course) Composition: vocal and instrumental, standard or modern idioms. Prerequisite: 18 credits in harmony, counterpoint, and piano. *Professor Henninger*

MUSIC 563. FREE ARRANGING (3) Correct procedure in arranging for vocal and instrumental ensembles; practical exercises in quartets, glee clubs, and choruses; small instrumental groups, band, and orchestra. Prerequisites: harmony 18 credits, including 3 of orchestration. *Professor Fishburn*

MUSIC 567. THE LITERATURE OF THE ORCHESTRA (3) The suite, symphony, tone poem, and overture from the point of view of appreciation, form, and orchestration. Prerequisites: Music 6 and theoretical knowledge of the key instruments of the orchestra. *Professor Fishburn*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MUSIC 407. PIANO REPERTOIRE (3) *Professor Brinsmaid*
MUSIC 408. VOCAL LITERATURE (3) *Mrs. Reynolds*
MUSIC 429-432. SINGER'S STYLE AND INTERPRETATION (3 per course) Fee $25 per course. *Professor Taylor*
MUSIC 456. ELEMENTARY COUNTERPOINT (3) *Professor Henninger*
MUSIC 464. MUSICAL LITERATURE OF THE ROMANTIC PERIOD (3) *Professor Fishburn*
MUSIC 465. MUSICAL LITERATURE OF THE MODERN PERIOD (3) *Professor Fishburn*
MUSIC 466. ADVANCED CONDUCTING (3) *Professor Gullo*

MUSIC EDUCATION

PROFESSOR HUMMEL FISHBURN, M.A., Mus.D.
Head of the Department

MUSIC ED. 500. MUSIC EDUCATION SEMINAR (3-6) Problems of various phases of music education, both instrumental and vocal; research and literature dealing with these problems.

MUSIC ED. 571. VOCAL PEDAGOGY (3) Detailed study of vocal problems met in public schools, elementary through high school; vocal class pedagogy and literature; daily voice training. Prerequisites: Music Ed. 48 and teaching experience.

MUSIC ED. 572. INSTRUMENTAL PEDAGOGY (3-6) Research problems in the fields of band and orchestra. Prerequisite: Music Ed. 54 or practical experience.

MUSIC ED. 573. THE MATERIALS OF APPRECIATION (3) Methods and materials for the development of music appreciation in the elementary and secondary schools. Prerequisites: Music 5 and teaching experience.

MUSIC ED. 574a,b. PRESENT-DAY TRENDS IN MUSIC EDUCATION (3-6) Present-day music education materials and methods (elementary and secondary levels) in relation to modern educational philosophy; emphasis upon practical problems pre-

sented by members of the class. Prerequisites: Music Ed. 48 and teaching experience.

Music Ed. 575. The Junior High School Music Curriculum (3) Instructional materials, procedures, curricular and extracurricular activities, integration with other subjects. Lecture 3 hours.

Music Ed. 590. Thesis (3-15)

Music Ed. 594. Pedagogy of Ear Training (3) Materials and methods for training the listener to grasp, understand, and write what is heard from melody to four-part harmony. Prerequisite: 12 credits in ear training and/or harmony.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Music Ed. 401. Music in the Rural Area (3)
Music Ed. 462. Pedagogy of Theory (3)
Music Ed. 468. The Teaching of Piano (3)
Music Ed. 469. Band and Orchestra Technique (3)
Music Ed. 470. Choral Technique (3)
Music Ed. 475. Objectives and Problems in Elementary Music Education (3)

PETROLEUM AND NATURAL GAS

Professor John C. Calhoun, M.S., Ph.D.
Chief of the Division

Pet.E. 500a. Petroleum and Natural Gas Engineering Research (3-9 per semester)

Pet.E. 501. Energetics of Petroleum Engineering (3) Applications of thermodynamics to special problems in production of petroleum and natural gas. Prerequisite: M.E. 2.

Pet.E. 502a. Petroleum and Natural Gas Engineering Seminar (3-9) An intensive study of one or several phases of petroleum engineering.

Pet.E. 503. The Flow of Homogeneous Fluids Through Porous Media (3) Flow and pressure distributions for various geometric patterns for steady and unsteady states. Prerequisite: Math. 431.

Pet.E. 504. Water Flooding (3-6) Continuation of Pet.E. 485 with emphasis on special problems. Prerequisite: Chem. 40.

Pet.E. 506. Advanced Petroleum Engineering (5) Advanced problems in petroleum and natural gas production. Prerequisites: Chem. 41, Pet.E. 74.

Pet.E. 507. Condensate Fields (2) Retrograde condensation phenomenon of hydrocarbon mixtures at high pressure; literature on condensate fields; production

methods and equipment design: casing heads, compressors, separators, stabilizers; safety measures. Prerequisite: Pet.E. 501.

Pet.E. 508. Colloidal Behavior of Industrial Clays, Muds, and Slimes (2-3) Principles of colloidal activity applied to the control of the properties of clay slips, drilling fluids, and similar suspensions. (In co-operation with the Ceramics staff.) Prerequisite: Chem. 41. *Professor Henry*

Pet.E. 509. Advanced Petroleum Engineering Design (2) Continuation of Pet.E. 84. Projects in the selection of engineering materials for casing programs, drilling rigs; production, treatment, stabilization, and transportation of crude oils. Prerequisite: Pet.E. 84.

Pet.E. 510. Modern Methods of Hydrocarbon Analyses (3)

Pet.E. Lab. 508. Rotary Drilling Fluid Laboratory (1) Supplementary to Pet.E. 508. Prerequisite: Chem. 41. Concurrent: Pet.E. 508.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Pet.E. 481. Natural Gas and Gasoline Plants (4)
Pet.E. 485. Secondary Recovery (3)
Pet.E. 491. Oil and Gas Reservoir Engineering (3)
Pet.E. Lab. 481. Natural Gas Laboratory (1)
Pet.E. Lab. 490. Advanced Core Testing (3)

PHILOSOPHY

Professor John A. Mourant, M.A., Ph.D.
Head of the Department

Phil. 500a,b. Ethical Seminar (2-6) A critical study of some phase of ethical fact and theory.

Phil. 501a,b,c,d. Philosophy Seminar (2-12) Meets the demand for advanced study in special fields of philosophical thought.

Phil. 502. Theory of Epistemology (3) A systematic and critical analysis of some aspect of contemporary epistemology.

Phil. 503. Logic (3) The logical basis of mathematics and its ultimate nature.

Phil. 504. Social and Political Philosophy (3) A critical study of basic problems in their historical and functional setting.

Phil. 505. Ideals of Western Civilization (3) An analysis of contemporary ideals in terms of their Graeco-Judean bases.

PHIL. 507. SEMINAR IN HISTORY OF PHILOSOPHY (3-12) Concentrated study of some work or problem in the history of philosophy.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PHIL. 401. RELIGIOUS PHILOSOPHY OF THE GREAT REFORMERS (3)
PHIL. 408. ADVANCED SOCIAL AND POLITICAL PHILOSOPHY (3)
PHIL. 409. PHILOSOPHY OF ST. THOMAS AQUINAS (3)
PHIL. 415. THE PHILOSOPHY OF KANT (3)
PHIL. 418. RECENT AND CONTEMPORARY PHILOSOPHY (3)
PHIL. 426. METAPHYSICS (3)
PHIL. 427. ADVANCED ETHICS (3)
PHIL. 428. ADVANCED LOGIC (3)
PHIL. 430. HONORS COURSE IN PHILOSOPHY (3)

PHYSICAL EDUCATION

Consult PROFESSOR LLOYD M. JONES, M.A., Ph.D.

PHYS. ED. 500. PROBLEM IN PHYSICAL EDUCATION (3) Prerequisite: Phys. Ed. 455.

PHYS. ED. 522. ORGANIZATION AND ADMINISTRATION OF PHYSICAL EDUCATION IN COLLEGES AND UNIVERSITIES (3) Administration of physical education in college; credits, schedules, excuses, records, reports, budgets, classification, tests, staff, and facilities. Prerequisite: Phys. Ed. 491. *Professor Thiel*

PHYS. ED. 523. ADMINISTRATION OF COLLEGE ATHLETICS (3) Eligibility, schedules, managerial systems, the relationships of athletics to the physical education program and to education in general. Prerequisite: Phys. Ed. 491. *Professor Bedenk*

PHYS. ED. 526. ATHLETIC PROBLEMS IN SCHOOLS (3) Practical problems which result from the administration of athletics in schools. Reports on some aspects of athletics required. Prerequisites: Phys. Ed. 460, 481. *Professor Bedenk*

PHYS. ED. 528. PROFESSIONAL EDUCATION OF TEACHERS OF HEALTH AND PHYSICAL EDUCATION (3) Health and physical education surveys, publicity, sociability and personality tests, legislation, state certification, standards for facilities and equipment, in-service, follow-up, and teacher-community problems. Prerequisite: Phys. Ed. 491. *Professor Jones*

PHYS. ED. 529. SUPERVISION OF PHYSICAL EDUCATION IN SCHOOLS (3) Methods and policies of the school supervisor of physical education; conferences, planning and presenting the program, evaluating results, improving teachers-in-service, supervision of the classroom teacher. Prerequisites: Phys. Ed. 452, 453, 491. *Professor Jones*

PHYS. ED. 530. RESEARCH TECHNIQUES IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Phys. Ed. 490. *Professor Lawther*

PHYS. ED. 531. RESEARCH IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Phys. Ed. 530. *Professor Masley*

PHYS. ED. 532. TESTS AND MEASUREMENTS IN PHYSICAL EDUCATION (3) Critical study of the tests and measurements available in physical education; methods of constructing and evaluating new tests and measurements. Prerequisite: Phys. Ed. 490. *Professor Masley*

PHYS. ED. 534. STUDIES IN CURRICULUM CONSTRUCTION IN PHYSICAL EDUCATION (3) Principles and methods of curriculum building in physical education; the different psychological and educational points of view, organizing a course of study committee, making units of instruction. Prerequisites: Phys. Ed. 452, 453, 454. *Professor Jones*

PHYS. ED. 535. MODERN FOREIGN SYSTEMS OF PHYSICAL EDUCATION (3) Comparative analysis of national and local programs and systems of physical education in foreign countries. Prerequisites: Phys. Ed. 534, 595. *Professor Speidel*

PHYS. ED. 536. SCIENTIFIC METHODS IN ATHLETIC COACHING (3) Unusual techniques in athletic coaching which are not commonly recognized and used; advanced skills and strategy in coaching major sports. Prerequisite: Phys. Ed. 460. *Professor Lawther*

PHYS. ED. 550. SEMINAR IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (1-6) Open only to students preparing approved theses and dissertations. *Professor Jones and Staff*

PHYS. ED. 555. RELATIONSHIPS OF PHYSICAL EDUCATION TO THE EXACT SCIENCES (3) Prerequisite: Phys. Ed. 581. *Professor Lucey*

PHYS. ED. 560. ADMINISTRATIVE PROBLEMS OF PHYSICAL EDUCATION IN SCHOOLS (3) Solutions to problems emerging from the administration of physical education in schools, fitting physical education into the school's schedule, awards and budgets. Prerequisite: Phys. Ed. 491. *Professor Jones*

PHYS. ED. 581. PROBLEMS IN BODY MECHANICS (3) Certain aspects of human motion and body segmental alignment; analysis of human gait, and the dynamic adaptation of the spine, thorax, and pelvis to external physical forces. Prerequisites: Health Ed. 244, Phys. Ed. 399. *Professor Kelly*

PHYS. ED. 595. PHILOSOPHY OF HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Health Ed. 453 or Phys. Ed. 465 or 491. *Professor Jones*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PHYS. ED. 424. MODERN TRENDS IN HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS (3) *Professor Jones*

PHYS. ED. 429S. THE MODERN DANCE IN EDUCATION (3) *Professor Briant*

PHYS. ED. 431S. COACHING OF ADVANCED BASEBALL (3) *Professor Bedenk*

PHYS. ED. 436S. COACHING OF ADVANCED FOOTBALL (3) *Professor Bedenk*
PHYS. ED. 437S. COACHING OF ADVANCED BASKETBALL (3) *Professor Gross*
PHYS. ED. 438S. COACHING OF ADVANCED TRACK (3) *Professor Werner*
PHYS. ED. 439S. COACHING OF ADVANCED SOCCER (3) *Mr. Jeffrey*
PHYS. ED. 440S. COACHING OF ADVANCED GYMNASTICS (3) *Professor Wettstone*
PHYS. ED. 441S. ADVANCED COACHING OF ATHLETICS FOR MEN (1-11)
Unit A. Basketball (1) *Professor Gross*
Unit B. Football (1) *Professor Bedenk*
Unit C. Track and Field (1) *Professor Werner*
Unit D. Baseball (1) *Professor Bedenk*
Unit E. Wrestling (1) *Professor Speidel*
Unit F. Soccer (1) *Mr. Jeffrey*
Unit G. Swimming (1) *Mr. Gutteron*
Unit H. Gymnastics (1) *Professor Wettstone*
Unit I. Boxing (1) *Mr. Sulkowski*
Unit J. Lacrosse (1) *Professor Thiel*
Unit K. Fencing (1) *Professor Meyer*
PHYS. ED. 449S. ADVANCED TEACHING OF SPORTS AND RHYTHMICS (1-11)
Unit A. Soccer and Speedball (1) *Professor Lucey*
Unit B. Basketball (1) *Professor Lucey*
Unit C. Field Hockey (1) *Professor Lucey*
Unit D. Archery (1) *Professor Haidt*
Unit E. Swimming (1) *Miss Leonard*
Unit F. Rhythmics for Children (1) *Professor Briant*
Unit G. Modern Dance and Accompaniment (1) *Professor Briant*
Unit H. Early American Country Dancing and Social Dancing (1) *Professor Briant*
Unit I. Tennis (1) *Professor Lucey*
Unit J. Badminton (1) *Professor Lucey*
Unit K. Golf (1) *Mr. Rutherford*
PHYS. ED. 452S, 452X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE ELEMENTARY SCHOOL (3) *Professor Speidel*
PHYS. ED. 453S, 453X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE HIGH SCHOOL (3) *Professor Bischoff*
PHYS. ED. 454. THE NATURAL PROGRAM OF PHYSICAL EDUCATION ACTIVITIES, APPLIED (3) *Professor Bischoff*
PHYS. ED. 455. SCIENTIFIC METHOD IN HEALTH AND PHYSICAL EDUCATION (3) *Professor Masley*
PHYS. ED. 460. METHODS AND PRINCIPLES OF ATHLETIC COACHING (3) *Professor Lawther*
PHYS. ED. 466S. VISUAL INSTRUCTION IN ATHLETICS (3) *Professor Conger*
PHYS. ED. 471S. HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS FOR THE SCHOOL ADMINISTRATOR (3) *Professor Jones*
Unit A. Athletics in the Schools (1)
Unit B. Health Education in the Schools (1)
Unit C. Physical Education and Recreation in the Schools (1)
PHYS. ED. 480. ADVANCED ANATOMY AND PHYSIOLOGY, APPLIED (3) *Professor Kelly*

PHYS. ED. 482, 482X. POSTURE EDUCATION IN THE SCHOOLS (3) *Professor Kelly*
PHYS. ED. 488S. THE ADMINISTRATION OF PHYICAL EDUCATION AND ATHLETICS FOR WOMEN (3) *Professor Haidt*
PHYS. ED. 489. INTRAMURAL ATHLETICS (3) *Professor Bischoff*
PHYS. ED. 490. INTRODUCTION TO TESTS AND MEASUREMENTS IN HEALTH AND PHYSICAL EDUCATION (3) *Professor Masley*
PHYS. ED. 491. ORGANIZATION AND ADMINISTRATION OF HEALTH AND PHYSICAL EDUCATION IN SCHOOLS (3) *Professor Jones*

PHYSICS

PROFESSOR HAROLD K. SCHILLING, M.A., Ph.D.
Head of the Department

PHYS. 501a,b,c,d,e. PHYSICS RESEARCH (1-15 per semester) Original work to obtain material for a thesis. May be continued in successive semesters as Phys. 501b, 501c, etc. to a maximum of 45 credits.

PHYS. 507. THEORETICAL THERMODYNAMICS (3) A mathematical treatment of the principles of thermodynamics.

PHYS. 509. PHYSICS SEMINAR (1) Selected topics from current physical research critically examined and discussed. May be continued in successive semesters as Phys. 509a, 509b, 509c.

PHYS. 517. KINETIC THEORY (3) The Maxwell-Boltzmann law, Brownian movements, specific heats, and other selected topics. Prerequisites: Phys. 411, Math. 431.

PHYS. 521. CRYSTAL STRUCTURE (3) The solution of the structure of crystals by X-ray methods. Available for major credit in either physics or chemistry.

PHYS. 522. ADVANCED CRYSTAL ANALYSIS (3) Continuation of Phys. 521, including the application of crystal structure studies to physical, chemical, and metallurgical problems. Available for major credit in either physics or chemistry.

PHYS. 530. INTRODUCTION TO THEORETICAL PHYSICS (3) The application of higher mathematics to problems in the various fields of physics. Prerequisites: Math. 431, Phys. 285.

PHYS. 531. THEORETICAL PHYSICS (3) Continuation of Phys. 530.

PHYS. 533. THEORY OF SOUND (3) Mathematical treatment of the theory of sound. Prerequisite: Phys. 530.

PHYS. 551. ADVANCED ELECTRON THEORY (1-3) Properties of matter in terms of modern electron theory. Prerequisite: Phys. 531.

PHYS. 553. NUCLEAR PHYSICS (3) Mathematical course in nuclear physics. Prerequisite: Phys. 562.

PHYS. 557. ELECTRICITY AND MAGNETISM (3) A treatment of the mathematical theory of electricity and magnetism. Prerequisite: Phys. 467.

PHYS. 558. ELECTRICITY AND MAGNETISM (3) Continuation of Phys. 557. Prerequisite: Phys. 557.

PHYS. 559. PHYSICAL OPTICS (3) Advanced study of the physical properties of light. Prerequisite: Phys. 459.

PHYS. 560. ADVANCED PHYSICAL MEASUREMENTS (1-18) Offers opportunity for advanced work in the various fields of physics.

PHYS. 561. DE BROGLIE WAVES AND QUANTUM MECHANICS (3) An introduction to the modern interpretation of atomic structure and radiation phenomena, based upon the de Broglie and Schroedinger wave theory. Prerequisite: Phys. 531.

PHYS. 562. WAVE MECHANICS IN MODERN PHYSICS (3) This continuation of Phys. 561 discusses the theory of atomic and simple molecular spectra, Zeeman and Stark effect, theories of metallic conductivity and thermionic emission, etc. Prerequisite: Phys. 561.

PHYS. 571. ATOMIC STRUCTURE (3) Recent work in atomic and subatomic physics.

PHYS. 572. SPECTROSCOPY (3) Atomic and molecular spectra, both emission and absorption methods of excitation, radiation and ionization potentials, spectral series, fine structure, spectra of ionized and stripped atoms.

PHYS. 575. PROBLEMS IN MODERN PHYSICS (1-3) Theoretical studies in any field of modern physics with or without associated experimental work. Prerequisite: Phys. 455.

PHYS. 577. CLASSICAL MECHANICS (3) The principles and applications of classical mechanics. Prerequisite: Phys. 461.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PHYS. 400. INTERMEDIATE ELECTRICITY AND MAGNETISM (4)
PHYS. 402. ELECTRONICS (4)
PHYS. 404. ELECTRONIC MEASUREMENTS (2-4)
PHYS. 411. THEORETICAL MECHANICS (3)
PHYS. 417. THE TEACHING OF PHYSICS (3)
PHYS. 420. INTERMEDIATE HEAT (3)
PHYS. 433S. INTERMEDIATE MECHANICS AND FLUID PHYSICS (3)
PHYS. 435S. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
PHYS. 437S. INTERMEDIATE HEAT, SOUND, AND LIGHT (3)
PHYS. 439S. ELEMENTARY SURVEY OF MODERN PHYSICS (3)
PHYS. 443. INTERMEDIATE ACOUSTICS (3)
PHYS. 444. MEASUREMENTS IN ACOUSTICS (2)
PHYS. 454. ATOMIC AND NUCLEAR PHYSICS (3)
PHYS. 456. ATOMIC AND NUCLEAR PHYSICS (3)

PHYS. 457. EXPERIMENTAL ATOMIC PHYSICS (2)
PHYS. 458. INTERMEDIATE OPTICS (4)
PHYS. 461. THEORETICAL MECHANICS (3)
PHYS. 467. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
PHYS. 477. X-RAY ANALYSIS OF SOLIDS AND LIQUIDS (3)
PHYS. 486. ASTRONOMICAL PHOTOGRAPHY (3-6)
PHYS. 490. MODERN STELLAR THEORY (3-9)
PHYS. 491S. ADVANCED CELESTIAL MEASUREMENTS (3-9)

POLITICAL SCIENCE

PROFESSOR M. NELSON MCGEARY, M.A., Ph.D.
Head of the Department

POL. SCI. 500. SEMINAR IN POLITICAL SCIENCE (3-12) Subject to be announced.
POL. SCI. 505. SEMINAR IN ADVANCED AMERICAN GOVERNMENT (3-12)
POL. SCI. 508. RESEARCH IN PUBLIC ADMINISTRATION (3-12)
POL. SCI. 509. RESEARCH TECHNIQUES IN POLITICAL SCIENCE (3)
POL. SCI. 510. POLITICAL AND ADMINISTRATIVE PROBLEMS IN PENNSYLVANIA (3-6)
POL. SCI. 512. COMPARATIVE GOVERNMENT (3-12)
POL. SCI. 515. INTERNATIONAL RELATIONS (3-6)
POL. SCI. 516. INTERNATIONAL LAW (3-6)
POL. SCI. 517. INTERNATIONAL ORGANIZATION (3-6)
POL. SCI. 519. PUBLIC ADMINISTRATION (3-6)
POL. SCI. 520. ADMINISTRATIVE LAW (3-6)
POL. SCI. 521. POLITICAL THEORY (3-6)
POL. SCI. 525. POLITICAL PARTIES (3-6)
POL. SCI. 526. PUBLIC OPINION AND PROPAGANDA (3-6)
POL. SCI. 533. LABOR AND WELFARE LEGISLATION (3-6)
POL. SCI. 535. GOVERNMENT REGULATION (3-6)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

POL. SCI. 411. AMERICAN POLITICAL THEORY (3)
POL. SCI. 413. GOVERNMENT AND FOREIGN POLICY OF THE SOVIET UNION (3)
POL. SCI. 415. INTERNATIONAL ORGANIZATION (3)
POL. SCI. 416. INTERNATIONAL LAW (3)
POL. SCI. 417. MUNICIPAL GOVERNMENT (3)
POL. SCI. 419. PUBLIC ADMINISTRATION (3)
POL. SCI. 420. PUBLIC PERSONNEL (3)
POL. SCI. 421. MODERN POLITICAL THEORIES (3)
POL. SCI. 424. STATE GOVERNMENT IN THE UNITED STATES (3)
POL. SCI. 427. PUBLIC OPINION AND PROPAGANDA (3)
POL. SCI. 428. PENNSYLVANIA LOCAL GOVERNMENT (3)

Pol. Sci. 429. Pennsylvania Local Administration (3)
Pol. Sci. 431. Ancient and Medieval Political Theories (3)
Pol. Sci. 432. Current Political Trends and Problems in the United States (3-9)
Pol. Sci. 433. Labor and Welfare Legislation and Administrative Problems (3)
Pol. Sci. 435. Government Housing, Planning, and Public Works (3)
Pol. Sci. 442. American Foreign Policy (3)
Pol. Sci. 444. Government Regulation (3)
Pol. Sci. 445. Administrative Law (3)
Pol. Sci. 446. Judicial Systems (3)
Pol. Sci. 450. Government and Foreign Policies of Britain and the Commonwealth (3)
Pol. Sci. 452. Governments and Foreign Policies of Western Europe (3)
Pol. Sci. 454. Governments and Foreign Policies of Eastern Europe (3)
Pol. Sci. 456. Governments and Foreign Policies of Latin America (3)
Pol. Sci. 458. Governments and Foreign Policies of the Far East (3)
Pol. Sci. 499X. Foreign Study in Government (2-6)

PORTUGUESE

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

Port. 571. Seminar in Portuguese Literature (3-6) Prerequisite: Port. 4.

POULTRY HUSBANDRY

Professor Ernest W. Callenbach, M.S.
Head of the Department

P.H. 502. Advanced Poultry Nutrition (2-4) Prerequisite: P.H. 3. *Professor Murphy*

P.H. 503. Advanced Poultry Farm Management (2-4) Prerequisite: P.H. 8. *Professor Bressler*

P.H. 504. Advanced Market Poultry and Eggs (2-4) Prerequisites: P.H. 1, 7; Agr. Ec. 33 or 2 additional credits in poultry husbandry. *Professor Margolf*

P.H. 505. Research in Poultry Husbandry (3-10) Prerequisite: 9 credits in poultry husbandry. *Professor Callenbach and Staff*

P.H. 506. Seminar in Poultry Husbandry (1-6) *Professor Callenbach and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

P.H. 412. Poultry Breeding (3) *Professor Maw*

PSYCHOLOGY

PROFESSOR BRUCE V. MOORE, M.A., Ph.D.
Head of the Department

PSY. 500. SEMINAR: INTRODUCTION TO RESEARCH METHODS (1) Prerequisite: 12 credits in psychology.

PSY. 501. ADVANCED PSYCHOLOGY (3) A comprehensive study of general psychology. Prerequisite: 9 credits in psychology. *Professor Lepley*

PSY. 502. ADVANCED EDUCATIONAL PSYCHOLOGY (2-4) Psychological theories and principles underlying educational theories and practices. Prerequisites: Psy. 14 or 414; Ed. 31 or teaching experience. *Professor van Ormer*

PSY. 503. PHYSIOLOGICAL PSYCHOLOGY (2-6) Correlations between structure and function of nervous system and human consciousness; laws and theories in fields of sensation, attention, association, affection, and thought. Prerequisite: 9 credits in psychology. *Professor DeCamp*

PSY. 504. COMPARATIVE PSYCHOLOGY (2-4) Behavior from standpoint of phylogenetic growth and development; biological implications; comparison of different types of animals, including man. Prerequisite: 9 credits in psychology. *Professor Carpenter*

PSY. 505. RESEARCH PROBLEMS IN PSYCHOLOGY (1-15) Prerequisite: 12 credits in psychology.

PSY. 506. CLINICAL PSYCHOLOGY (1-6) Procedures used in the Psychology Clinic. Limited to students enrolled in Psy. 560. Prerequisites: Ed. 70 or Psy. 471; Psy. 550 or 551. *Professor Snyder*

PSY. 509. ADVANCED THEORY OF LEARNING AND HABIT FORMATION (2-3) Critical evaluation of the major theories of learning: Hull, Guthrie, Tolman, Lewin. Application of learning theory to major problems in psychology. Prerequisite: Psy. 4 or 407 or 414. *Professor Grosslight*

PSY. 510. HISTORY OF PSYCHOLOGY (3) The theoretical systems, experiments, and personalities in the development of modern psychology until about 1920. Prerequisite: 9 credits in psychology. *Professor Carpenter*

PSY. 511. CONTEMPORARY AMERICAN PSYCHOLOGY (2-3) Current systems or schools of psychology with comparative study and critical analysis; points of view as presented by recognized leaders. Prerequisite: 9 credits in psychology. *Professor Lepley*

PSY. 513. EDUCATIONAL PSYCHOLOGY: DIFFERENTIAL (2) Causes of differences in achievement and personality; psychological implications of the methods used by schools in adjusting to individual differences. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor van Ormer*

PSY. 514. EDUCATIONAL PSYCHOLOGY: LEARNING (2) Experimentally determined facts about the learning process; synthesis of main theories of learning; application of principles related to: motivation, practice, retention, transfer, meaning, and problem solving. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor van Ormer*

PSY. 515. ADVANCED STATISTICS IN PSYCHOLOGY AND EDUCATION (3) Sampling, tests of significance, factor analysis, analysis of variance and other advanced statistical methods; the application of statistical methods to practical problems. Prerequisite: Psy. 415 or Ed. 574. *Professor Kurtz*

PSY. 517. PSYCHOLOGY OF ATTITUDES AND OPINIONS (3) Acquisition and control of attitudes and opinions, including beliefs, convictions, biases, prejudices, and ideologies as determinants of action. Prerequisite: 18 hours in psychology, including Psy. 417, 422, 437. *Professor Carpenter*

PSY. 521. RESEARCH PROBLEMS IN INDUSTRIAL PSYCHOLOGY (2-6) Actual industrial personnel problems in laboratory and industrial plants: monotony, fatigue, psychological selection, and training procedures. Prerequisites: Psy. 21 or 421; 431. *Professor Kinsley Smith*

PSY. 522. ADVANCED PSYCHOLOGICAL MARKETING RESEARCH TECHNIQUES (3-6) Technical aspects of sampling; construction, tabulation, and interpretation of questionnaires to test consumer reaction to products, advertising, and company policies. Prerequisite: 15 credits in psychology, including Psy. 15, 21, 422. *Professor Guest*

PSY. 528. OPINION RESEARCH ADMINISTRATION (3-6) Practicum in the planning, development of techniques, and administration of the sample survey. Prerequisites: Psy. 422, 428. *Professor Guest*

PSY. 534. APPLICATIONS OF PSYCHOLOGY IN BIO-MECHANICS (2) Experimental studies of psychological factors affecting design and operation of machines. Prerequisites: Psy. 3 and 4, or 501. *Professor Kinsley Smith*

PSY. 539. MOTIVATION AND EMOTION (3) Systematic status of instinct, drive, motive, will, purpose; methodology and results of physiological, experimental, and clinical investigation of basic drives. Prerequisites: Psy. 3, 4. *Professor Kendon Smith*

PSY. 540. CLINICAL PSYCHOLOGY SEMINAR (1-6) Seminar on current problems in clinical psychology. Prerequisite: Psy. 482.

PSY. 541. DYNAMICS OF HUMAN ADJUSTMENT (3) Seminar on motivation of human behavior, frustration, and mechanisms of adjustment; normal behavior is stressed. Prerequisite: Psy. 437. *Professor Bernreuter*

PSY. 542. PSYCHOPATHOLOGY (3) Covers basic, developmental, human, experimental reactions, showing how normal and pathological character trends and deviations evolve; basic reasons for and applications of psychotherapeutic methods. Prerequisite: Psy. 412 or 437. *Professor Lott*

PSY. 543. COUNSELING TECHNIQUES (2) Survey of psychotherapeutic methods; history, theory, and methods employed; case illustrations. Prerequisite: Psy. 482.
Professor Snyder

PSY. 550. PSYCHOMETRICS: BINET (2) Measurement of intelligence by Stanford revision of the Binet-Simon technique; demonstrations, lectures; practice administering tests; observations of student by instructor. Prerequisite: Psy. 471.

PSY. 551. PSYCHOMETRICS: POINT SCALES (2) Measurement of intelligence by individual nonverbal techniques: Arthur, Wechsler-Bellevue, and others; demonstrations, lectures, and practice administering tests under observation. Prerequisite: Psy. 471.

PSY. 552. PSYCHOMETRICS: PRESCHOOL (2) Measurement by individual preschool scales: Merrill-Palmer, Minnesota, California First Year; demonstrations, lectures, and practice in administering tests under observation. Prerequisite: Psy. 551.

PSY. 553. PSYCHOMETRICS: ADVANCED (2) Measurement of intelligence, social maturity, and other characteristics; demonstration, lectures, and practice in administering tests; observations by instructor. Prerequisite: Psy. 550.
Professor Bernreuter

PSY. 554. PSYCHOMETRICS: SENSORY (2-3) Measurement of auditory and visual acuity and defects; psychophysiological theory; demonstrations, lectures, and practice in administering and interpreting tests under observation. Prerequisite: Psy. 4.

PSY. 555. PSYCHOMETRICS: RORSCHACH ADMINISTRATION (3) Introduction to theory of projective tests; supervised practice in administering and scoring of the Rorschach test. Prerequisite: Psy. 550 or 551. *Professor Guthrie*

PSY. 556. PSYCHOMETRICS: RORSCHACH INTERPRETATION (3) Study of current literature and supervised practice. Prerequisite: Psy. 555. *Professor Guthrie*

PSY. 557. PSYCHOMETRICS: ADVANCED PROJECTIVE TECHNIQUES (2-3) Survey of common projective techniques other than the Rorschach, with supervised practice. Prerequisites: Psy. 555, 556. *Professor Guthrie*

PSY. 560. CLINICAL PRACTICUM (2-3) Applied experience in techniques of clinical psychology; case work in Psychology Clinic. Prerequisites: Psy. 482, 550, 551.

PSY. 561. CLINICAL PRACTICUM: ELEMENTARY SCHOOL (1-3) Experience in the Psychology Clinic and public schools in learning and adjustment problems; diagnosis and remedial work; pertinent school laws and practices. Prerequisites: Psy. 560 and Ed. 70, or Ed. 432g or 470.

PSY. 562. CLINICAL PRACTICUM: VOCATIONAL GUIDANCE (1-3) Practical experience in the Psychology Clinic on high school, college, and adult vocational guidance cases; staff meetings; seminar on techniques and materials. Prerequisites: Psy. 560 or Ed. 453, Ed. 474 and Psy. 472.

PSY. 563. CLINICAL PRACTICUM: MARITAL COUNSELING (1-3) Experience in the

Psychology Clinic on premarital and marital adjustment; seminar on techniques of adjustment and development of sexual and emotional maturity in marriage. Prerequisite: Psy. 560. *Professor Adams*

Psy. 564. Clinical Practicum: Personal Adjustment Counseling (2-3) Advanced practicum with experience in counseling of personal adjustment problems referred to the Psychology Clinic. Prerequisite: Psy. 565. *Professor Snyder*

Psy. 565. Clinical Practicum: Nondirective Counseling (3) Practical experience in application of the nondirective method, along with systematic theoretical study of the method. Prerequisites: Psy. 543, 560. *Professor Snyder*

Psy. 566. Clinical Practicum: Hypnotherapy (1-3) Practical experience in the Psychology Clinic in the use of hypnotherapy; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

Psy. 567. Clinical Practicum: Play Therapy (1-3) Practical experience in the Psychology Clinic in the use of play therapy with young children; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

Psy. 568. Clinical Practicum: Group Therapy (2) Practical experience in the Psychology Clinic in the use of group methods for the treatment of personal maladjustments; staff meetings; seminar on principles and techniques. Prerequisite: Psy. 565.

Psy. 574. Mental Deficiency (3) Causes of mental deficiency; diagnosis, training, and care of mental defectives. Prerequisites: Psy. 414 or 482.

Psy. 590. Seminar: Advanced (1-2) Prerequisite: Psy. 500.

Psy. 591. Seminar on Teaching Psychology (1-3) Objectives and content of psychology; organization and presentation of material; teaching aids and techniques. Prerequisites: Psy. 407 or 501; 510 or 511.

Psy. 599. Thesis (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Psy. 400. Honors Course in Psychology (2-6)
Psy. 407. Intermediate Experimental Psychology (3) *Professor Lepley*
Psy. 409. Psychobiology (3) *Professor Carpenter*
Psy. 411, 411X. Psychology of the Preschool Child (3) *Professors van Ormer and Thevaos*
Psy. 412, 412X. Abnormal Psychology (3) *Professor DeCamp*
Psy. 414, 414X. Intermediate Educational Psychology (2-3)
Psy. 415, 415X. Intermediate Statistics in Psychology and Education (3) *Professor Kurtz*
Psy. 417. Social Psychology (2-3) *Professor Carpenter*
Psy. 418. Measurement of Personality (2-3) *Professor Bernreuter*
Psy. 419. Guidance and Education in Sexual and Marital Adjustment (3) *Professor Adams*

PSY. 420. APPLIED SOCIAL PSYCHOLOGY (3) *Professors Carpenter and Kinsley Smith*
PSY. 421, 421X. ADVANCED APPLIED PSYCHOLOGY (3) *Professor Kinsley Smith*
PSY. 422. PSYCHOLOGICAL METHODS OF MEASURING THE REACTIONS OF THE PUBLIC (3) *Professor Guest*
PSY. 423. TEST CONSTRUCTION AND STANDARDIZATION (2-3) *Professor Kurtz*
PSY. 424, 424X. PSYCHOLOGICAL TECHNIQUES IN PUBLIC PERSONNEL ADMINISTRATION (3) *Professor Adams*
PSY. 425, 425X. PSYCHOLOGY OF THE ELEMENTARY SCHOOL CHILD (2-3) *Professor van Ormer*
PSY. 426, 426X. ADOLESCENCE (2-3) *Professors van Ormer and Thevaos*
PSY. 427. PSYCHOLOGICAL PRINCIPLES IN ADVERTISING (3) *Professor Guest*
PSY. 428. OPINION RESEARCH LABORATORY (3) *Professor Guest*
PSY. 431, 431X. INDUSTRIAL PSYCHOLOGY (3) *Professor Kinsley Smith*
PSY. 437, 437X. ADVANCED PSYCHOLOGY OF ADJUSTMENT AND MENTAL HYGIENE (3)
PSY. 438. THEORY OF PERSONALITY (3) *Professor Grosslight*
PSY. 440. PSYCHOLOGY PROJECTS (1-6)
PSY. 471, 471X. MEASUREMENT OF INTELLIGENCE (2) *Professor Bernreuter*
PSY. 472. SPECIAL ABILITY TESTING (2) *Professor Moore*
PSY. 482. INTRODUCTION TO CLINICAL PSYCHOLOGY (3) *Professor Snyder*
PSY. 495S. FAMILY HEALTH AND HUMAN RELATIONS (3-9)

PUBLIC UTILITIES

PROFESSOR ERIC A. WALKER, M.S., SC.D.
Head of the Department of Electrical Engineering

PUB. UTIL. 521. PUBLIC UTILITIES (3) Problems of current interest in the public utility field, principally those utilities involving the use of the principles of electrical engineering. *Professor Powell*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

PUB. UTIL. 421. ELECTRIC UTILITIES (3) *Professor Powell*

RECREATION

Consult PROFESSOR FRED M. COOMBS, M.A.

REC. 530. CAMP ADMINISTRATION (3) Camp site development; staff selection, training, and supervision; development of objectives and program planning; the values inherent in outdoor and camping education. Prerequisite: Rec. 430. *Professor Coombs*

REC. 533. RECREATION STUDIES, SURVEYS, AND APPRAISALS (3) Types, purposes, and

methods of conducting recreation studies and surveys; procedures on the appraisal of community recreation. Prerequisite: Phys. Ed. 530. *Professor Coombs*

REC. 560. ADMINISTRATIVE PROBLEMS OF RECREATION (3) Administrative problems in park and recreation departments; departmental organization, finance, personnel, facilities, program, and public relations. Prerequisite: Rec. 465.
Professor Coombs

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

REC. 430. CAMP COUNSELING (3) *Professor Coombs*
REC. 432. RECREATION IN INDUSTRY (3) *Professor Kessel*
REC. 456. SOCIAL RECREATION (3) *Professor Kessel*
REC. 461, 461X. PROGRAMS OF COMMUNITY RECREATION (1 per unit) *Professor Coombs*
Unit A. Programs of the Rural Community (1)
Unit B. Programs of the Urban Community (1)
Unit C. Programs of Large Municipalities (1)
REC. 462. RECREATION FOR THE HANDICAPPED (3) *Professor Speidel*
REC. 463. RECREATION LAW (3) *Professor Kessel*
REC. 465, 465X. ADMINISTRATION OF RECREATION (3) *Professor Coombs*

*RURAL SOCIOLOGY

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.
Head of the Department of Agricultural Economics and Rural Sociology

RUR. SOC. 551. RURAL SOCIOLOGY SEMINAR (1-6) Prerequisite: 6 credits in rural sociology, sociology, or psychology.

RUR. SOC. 552. THE STRUCTURE OF RURAL SOCIETY (3) Systematic review of research dealing with the structure of rural society; the purpose, methodology, and contribution of each study treated. Prerequisites: Rur. Soc. 11, Soc. 1.
Professor John

RUR. SOC. 553. RURAL SOCIAL PROCESSES (3) Continuation of Rur. Soc. 552. The functioning of rural society; research dealing with the subject reviewed and evaluated. Prerequisite: Rur. Soc. 552.

RUR. SOC. 554. ADVANCED RURAL SOCIAL WELFARE (3) Analysis of welfare techniques and their application to rural situations. Prerequisites: Rur. Soc. 11; Psy. 2 or Rur. Soc. 459. *Professor Mather*

RUR. SOC. 555. THE RURAL CHURCH (3) The rural church as a social institution; its relation to the community; the church in "problem" areas; effects of popula-

* Credit in rural sociology will also be given for Agr. Ec. 505 and 525.

tion trends on the program of the rural church; the use of case studies and surveys. Prerequisite: 6 credits in rural sociology, sociology, or psychology.
Professor Mather

Rur. Soc. 556. Thesis in Rural Sociology (6) A preparation of the required thesis for the degree of Master of Science in rural sociology while in residence at the College.

Rur. Soc. 557. The Development of the Rural Community (3) The origin and evolution of the rural community under different geographic and cultural conditions. Prerequisites: Rur. Soc. 11 or Soc. 1; Rur. Soc. 452 or Soc. 415a.
Professor Mather

Rur. Soc. 559. Advanced Rural Social Psychology (3) The application of social psychological principles to the treatment of rural problems. Prerequisites: Rur. Soc. 11, Psy. 2. *Professor John*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Rur. Soc. 452.	Rural Organization (3)	*Professor John*
Rur. Soc. 454.	Rural Social Welfare (3)	*Professor Mather*
Rur. Soc. 456.	Rural Standards of Living (3)	*Professor Mather*
Rur. Soc. 459.	Rural Social Psychology (3)	*Professor John*

SOCIOLOGY

Professor Seth W. Russell, M.A., Ph.D.
Head of the Department

Soc. 502. American Sociology (3) Special problems in sociological theory in the United States. Prerequisite: Soc. 402. *Professor L. L. Bernard*

Soc. 503. Seminar in Social Psychology (3-9) Investigation of the theories, methods, and empirical data of social psychology, with particular reference to such problems as the relations between personality and culture, social and personal disorganization, the development of role behavior, and the conception of the self. *Professor Coutu*

Soc. 504. Sociology of Knowledge (3) The social psychology of knowing; selective bases of judgments about reality; relation of knowledge to bias, experience, styles of thinking. Prerequisites: Soc. 400 or 401; 418, 425. *Professor Coutu*

Soc. 510. Field Work in Sociology (1-3) Advanced research projects to be carried out in the field under the supervision of the department and recognized social agencies.

Soc. 512. Seminar in Modern Criminology (3) Critical analysis of research in criminology and penology. *Professor Clark*

Soc. 513. Advanced Sociological Research Methods and Techniques (3) Special problems in scientific method and research techniques; designed to prepare the student for social inquiry on a professional level; embraces both quantitative and

nonquantitative types of work. Prerequisites: Soc. 413 and 3 credits of statistics. *Professor John*

Soc. 515. Structure and Functions of the Community (3) *Professor Jessie Bernard*

Soc. 516. Sociological Theory (3) *Professor L. L. Bernard*

Soc. 519. Seminar in Race Relations (3-6) The status and problems of minority peoples in selected areas of the world; analyses of the material, social, and sociopsychic aspects of race relations presented in lectures, reports, and papers.

Soc. 523. Advanced Research in Population (3) Supervised original research on some aspect of demographic phenomena and vital statistics; a genuine contribution to knowledge is expected of the student.

Soc. 525. Seminar in Sociology (1-9) Research problems in theoretical and applied sociology.

Soc. 530. Research on Marriage and the Family (3) Training in methods and techniques of research in family relations. Under the guidance of the instructor, experimental, statistical, and comparative studies are carried out, individually or co-operatively. Prerequisites: graduate standing and 3 hours' previous work in this field. *Professor Jessie Bernard*

Soc. 534. Problems in Social Control (3-12) Problems and processes of social control arising out of modern social conflict or planning. *Professor L. L. Bernard*

Soc. 540. Theory and Method in Anthropology (3) Theory and method used in culture-historical, sociological, and psychological interpretations. *Professor Mook*

Soc. 561. Seminar in Sociology of Religion (3) Prerequisites: Soc. 60 or 61; 415 or 418; 400 or 401. *Professors L. L. Bernard, S. W. Russell*

Soc. 572. Methods of Sampling (3) Application of sampling techniques to the field of sociological research. Prerequisite: Soc. 471. *Professor Clark*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Soc. 400. Sociological Theory (3) *Professors L. L. Bernard, S. W. Blizzard, Jr.*
Soc. 401. Social Institutions (3) *Professor Green*
Soc. 402. American Sociology (3) *Professor L. L. Bernard*
Soc. 403a. Advanced Social Psychology (3) *Professor Coutu*
Soc. 403b. Advanced Social Psychology (3) *Professor Coutu*
Soc. 405S. Social Problems (3)
Soc. 408. Social Ecology (3) *Professor Blizzard*
Soc. 413. Methods and Techniques of Social Research (1-6) *Professor Jessie Bernard*
Soc. 415a. Community Institutions (3) *Professor Jessie Bernard*
Soc. 418. The Development of Social Thought (3) *Professor L. L. Bernard*
Soc. 419. Minority Peoples (3)

Soc. 423.	Population Research (3)	
Soc. 424.	Social Changes (3)	*Professor Abramson*
Soc. 425.	Contemporary Sociological Theory (3)	*Professor L. L. Bernard*
Soc. 426.	Introduction to Public Welfare (3)	*Professor Mather*
Soc. 427S.	Family Case Work (6)	
Soc. 429.	Social Stratification (3)	
Soc. 431.	Mass Entertainment (3)	*Professor Abramson*
Soc. 435.	Social Control (3)	*Professor L. L. Bernard*
Soc. 440.	Cultural Anthropology (3)	*Professor Mook*
Soc. 441.	Folk Society (3)	*Professor Mook*
Soc. 442.	Anthropology of the New World (3)	*Professor Mook*
Soc. 443.	Anthropology of the Old World (3)	*Professor Mook*
Soc. 461.	Sociology of Religion (3)	*Professors L. L. Bernard, S. W. Russell*
Soc. 470.	The Use of Statistics in Sociology (3)	*Professor Clark*
Soc. 471.	Advanced Sociological Statistics (3)	*Professor Clark*
Soc. 495S.	Family Health and Human Relations (3)	
Soc. 499X.	Foreign Study in Sociology (2-6)	

SPANISH

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

Sp. 544. Neoclassicism in the Romance Literatures (3) The nature and development of the Neoclassic movement in Italy, France, Spain, and Portugal.

Sp. 545. Romanticism in the Romance Literatures (3) The nature and development of the Romantic movement in Italy, France, Spain, and Portugal.

Sp. 546. Medieval Romance Literatures (3) The nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal.

Sp. 547. Realism, with Particular Reference to Romance Literature (3)

Sp. 548. 20th Century Romance Literature as a Political Force (3)

Sp. 551. Romance Philology (3) Historical development of the Romance languages.

Sp. 552. Old Spanish Readings (3) Familiarizes the student with Old Spanish texts.

Sp. 554. The Renaissance in the Romance Literatures (3) Themes and forms of literature in the humanistic period.

Sp. 561. Spanish Drama Previous to Lope de Vega (3) Origin and early development of the Spanish national drama. Representative plays of different types will be read and discussed.

Sp. 562. Spanish Drama Previous to Lope de Vega (3) Continuation of Sp. 561.

Sp. 565. Lope de Vega (3)

Sp. 566. Lope de Vega's Followers (3)

Sp. 567. Cervantes and His Works (3)

Sp. 568. Cervantes and His Works (3)

Sp. 571. Seminar in Spanish Literature (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

Sp. 572. Seminar in Spanish Literature (3) Continuation of Sp. 571.

Sp. 599. Dissertation (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Sp. 401. The Golden Age (3)
Sp. 402. Drama of the Golden Age (3)
Sp. 403. Don Quixote (3)
Sp. 404. Old Spanish Language and Literature (3)
Sp. 405. Spanish Drama of the 19th Century (3)
Sp. 406. Contemporary Spanish Drama (3)
Sp. 407. The Spanish Novel of the 19th Century (3)
Sp. 408. The Contemporary Spanish Novel (3)
Sp. 409, 409X. Introduction to Latin-American Literature (3)
Sp. 410. Introduction to Latin-American Literature (3)
Sp. 411. Mexico: Its Language and Literature (3)
Sp. 412. Argentina: Its Language and Literature (3)
Sp. 415. Modern Spanish Lyric Poetry (3)
Sp. 417. Spanish Literature in the Romantic Period (3)
Sp. 421. The Teaching of Romance Languages (3)
Sp. 471. Problems in Spanish Literature (3-6)
Sp. 490. Advanced Composition and Conversation (3)
Sp. 496. Literary Criticism in France, Italy, and Spain (3)

SPEECH

Professor Robert T. Oliver, M.A., Ph.D., LL.D.
Head of the Department

Speech 500. Seminar in American Oratory (2-4) The history of American oratory, with the application of critical standards to the work of specific orators. Prerequisite: 6 credits in speech, including Speech 200. *Professor O'Brien*

Speech 505. Historical Development of Speech Theory (2-4) Survey of ancient, medieval, and modern theories of public address in relation to currently accepted speech theories. *Professor DeBoer*

SPEECH 508. SEMINAR IN BRITISH ORATORY (2-4) History of British oratory; application of critical standards to the work of selected orators. *Professor Fife*

SPEECH 510. SEMINAR IN METHODS OF TEACHING SPEECH (2-4) Curriculum construction, media, and methods in high school and college. Prerequisite: 6 credits in speech, including Speech 200. *Professor O'Brien*

SPEECH 520. SEMINAR IN SPEECH SCIENCE (2-4) A seminar in the physical and physiological bases of speech and voice; introduction to the laboratory techniques used in speech research. Prerequisite: 9 credits in speech, speech education, or psychology.

SPEECH 525. SEMINAR IN CLINICAL SPEECH PATHOLOGY (2-4) A physiological, neurological, and psychological view of the speech process together with a critical study of modern theories and practices in clinical speech pathology. Prerequisites: Speech 490, 491.

SPEECH 540. SEMINAR IN THE PROBLEMS OF RADIO (3) Advanced study and research in special problems in radio speech, radio production, and radio organization. Prerequisite: 6 hours of speech, including Speech 200, 300; 425 or 435. *Professor Nelson*

SPEECH 550. SEMINAR IN ORAL PERSUASION (2-3) Theory and devices of persuasion; analysis of persuasive discourse. Prerequisite: 6 credits in speech, including Speech 200. *Professor Carter*

SPEECH 555. SPEECH COMMUNICATION: PROBLEMS AND PRINCIPLES (2-4) Prevalent theories of speech influence. *Professor Oliver*

SPEECH 560. PUBLIC ADDRESS (2-4) Discussion and criticism of speech outline, manuscript, content, composition, and delivery. Prerequisite: 6 credits in speech, including Speech 200. *Professor Schug*

SPEECH 575. RESEARCH PROBLEMS IN SPEECH (1-12) Advanced research on an individual basis in oratorical criticism, discussion techniques, persuasion, pedagogy, phonetics, speech science, and speech pathology. Prerequisite: 12 credits in speech or in speech education.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

SPEECH 400. TEACHING OF SPEECH (3) *Professor Schug*
SPEECH 401. PROBLEMS, METHODS, AND AREAS IN SPEECH (1) *Professor Oliver*
SPEECH 405a,b,cS. PRACTICAL PROBLEMS IN PUBLIC AND PRIVATE SPEECH (1-3)
SPEECH 410. ENGLISH PHONETICS AND PRONUNCIATION (3) *Professor O'Brien*
SPEECH 411a,b,cS. SPEECH SCIENCE AND SPEECH ARTS (1-3)
SPEECH 412. SPEECH COMPOSITION (3) *Professor DeBoer*
SPEECH 415. APPLIED PHONETICS FOR CLINICIANS (3) *Professor Brong*
SPEECH 416. METHODS OF COACHING DEBATE (3)
SPEECH 425. ADVANCED PRINCIPLES OF RADIO SPEECH (3) *Professor Nelson*
SPEECH 431. ANATOMY AND PHYSIOLOGY OF THE EAR AND VOCAL MECHANISMS (3)

SPEECH 435. RADIO ORGANIZATION (3) *Professor Nelson*
SPEECH 437. PRINCIPLES OF TELEVISION SPEECH (3) *Professor Nelson*
SPEECH 445. SPEECH AS A MEDIUM OF INTERNATIONAL RELATIONS (3) *Professor Oliver*
SPEECH 450. DISCUSSION TECHNIQUES (3) *Professor O'Brien*
SPEECH 490. SPEECH DISORDERS AND THEIR TREATMENT (3) *Professor McDonald*
SPEECH 491. CLINICAL SPEECH PRACTICUM (1-3) *Professor McDonald*

SPEECH EDUCATION

Consult PROFESSOR EUGENE T. MCDONALD, M.Ed., D.Ed.

SPEECH ED. 537. ADVANCED SPEECH CORRECTION (1-6) The clincal speech procedures of examination, diagnosis, and treatment. Prerequisite: Speech Ed. 437 or Speech 491.

SPEECH ED. 540. ARTICULATION DISABILITIES (3) Speech-sound production disorders in children and adults; methods of examination, diagnosis, and treatment. Prerequisite: Speech 490 or Speech Ed. 436. *Professor McDonald*

SPEECH ED. 541. THE VOICE AND ITS DISORDERS (3) Physical, physiological, and psychological bases of voice production; causes, nature, and symptoms of its disorders; current clinical methods in voice improvement. Prerequisite: Speech Ed. 436 or Speech 490. *Professor Brong*

SPEECH ED. 542. STUTTERING AND ALLIED DISORDERS (3) Modern theories of the causes of disorders of rhythm; methods of examination, diagnosis, and treatment. Prerequisite: Speech 490 or Speech Ed. 436. *Professor Elliott*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

SPEECH ED. 430. PROBLEMS OF THE CHILD WITH A HEARING LOSS (3) *Professor McDonald*
SPEECH ED. 434. AUDIOMETRY (2) *Professor McDonald*
SPEECH ED. 435. CLINICAL PRACTICE WITH THE DEAF AND HARD-OF-HEARING (3)
SPEECH ED. 436. SPEECH DISABILITIES (3) *Professor Brong*
SPEECH ED. 437. SPEECH CORRECTION (1-3) *Professor Raabe*
SPEECH ED. 439X. FUNDAMENTALS OF SPEECH EDUCATION (3)
SPEECH ED. 439aX. METHODS IN SPEECH EDUCATION (3) *Professor Raabe*
SPEECH ED. 440, 440X. SPEECH EDUCATION AND REEDUCATION IN THE ELEMENTARY SCHOOL (2-3) *Professor Raabe*
SPEECH ED. 441S. CURRENT PROBLEMS IN SPEECH AND HEARING (1-6)
SPEECH ED. 442. SPEECH PATHOLOGY (3) *Professor Elliott*
SPEECH ED. 443. METHODS IN AUDITORY TRAINING AND SPEECH READING (3) *Professor Raabe*

ZOOLOGY

PROFESSOR EDWARD H. DUSHAM, M.S., Ph.D.
Head of the Department of Zoology and Entomology

ZOOL. 508. ADVANCED PARASITOLOGY (3) Advanced work on the structure, life cycle, and control of parasites. Prerequisites: Ent. 2, Zool. 432. *Professor Zeliff*

ZOOL. 509. TECHNIQUES IN WILDLIFE MANAGEMENT (3) Preparing study mounts, census making, management area mapping, methods of collecting data, and determining food habits from stomach contents. Prerequisite: Zool. 546. *Professor English*

ZOOL. 512. SEMINAR (1) The review of current zoological literature. Required of graduate students majoring in zoology and entomology. Prerequisite: 12 credits in zoology or entomology. *Professor English*

ZOOL. 513. RESEARCH (1-15 per semester) The prosecution of an assigned problem under the guidance of an instructor. Prerequisites: Zool. 410, 432, 437, 440 or 546. *Professor Dusham and Staff*

ZOOL. 532S. ANIMAL PARASITES (3) Structure, life cycle, and control. Prerequisite: Zool. 432.

ZOOL. 541. COMPARATIVE PHYSIOLOGY (3) The dynamics of vital processes as shown in members of the animal kingdom. Prerequisites: Zool. 25, 26; Agr. Biochem. 1; Agr. Biochem. 425 or Zool. 437. *Professor Frings*

ZOOL. 546. THE THEORY OF GAME MANAGEMENT (4) Fundamental principles underlying the management of wild game birds and mammals; the co-ordination of such management with the various land uses; the planning of preserves and other land areas. Prerequisites: Zool. 408, 420. *Professor English*

ZOOL. 547S. WILDLIFE MANAGEMENT (3) The basic principles concerned with the management of game birds and game mammals. Prerequisites: Zool. 25, 26, 420. *Professor English*

ZOOL. 551. FISHERIES MANAGEMENT (3) The basic principles underlying the management of inland waters for fish production. Prerequisite: Zool. 450.

ZOOL. 581. ADVANCED INVERTEBRATE ZOOLOGY (3) The morphology, physiology, taxonomy, and life histories of invertebrate animals. *Professor Frings*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ZOOL. 408. MAMMOLOGY (4) *Professor English*
ZOOL. 410. GENERAL LIMNOLOGY (3)
ZOOL. 414. HERPETOLOGY (3)
ZOOL. 415. THE LITERATURE OF VERTEBRATE ZOOLOGY (1)
ZOOL. 416. THE METHODS OF RESEARCH IN ZOOLOGY (2)
ZOOL. 417. INVERTEBRATE FAUNISTICS (4) *Professor Frings*

Zool. 418S. Field Ornithology (3)	*Professor Wood*
Zool. 419S. General Animal Ecology (3)	*Professor Blackburn*
Zool. 420. Game Birds (3)	*Professor English*
Zool. 432. Human Parasitology (3)	*Professor Zeliff*
Zool. 436. Protozoology (3)	*Professor Zeliff*
Zool. 437. Histology (4)	*Professor Newman*
Zool. 440. Embryology (4)	*Professor Newman*
Zool. 444. Zoological Problems (1-6)	*Professor Dusham and Staff*
Zool. 445S. The Identification of Insects (3)	
Zool. 447. Aquiculture (2)	
Zool. 448. Ornithology (3)	*Professor Wood*
Zool. 450. Ichthyology (4)	

The Pennsylvania State College Bulletin

GRADUATE SCHOOL ANNOUNCEMENT

1952

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1953

PENN STATE COLLECTION

THE PENNSYLVANIA STATE COLLEGE BULLETIN

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STATE COLLEGE, PENNSYLVANIA

The Pennsylvania State College Bulletin

GRADUATE SCHOOL ANNOUNCEMENT

1952

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COLLEGE

SPRING SEMESTER 1952

JANUARY 1952

JAN. 31 }
FEB. 1-2 } Thursday to Saturday—Spring Semester Registration

FEBRUARY

4 Monday—Spring Semester Classes Begin 8 a. m.

APRIL

9 Wednesday—Spring Recess Begins 11:50 a. m.
16 Wednesday—Spring Recess Ends 1:10 p. m.

MAY

5-6 Monday and Tuesday—First Phase Registration for Fall Semester 1952
27 Tuesday—Spring Semester Classes End 5 p. m.
28 Wednesday—Spring Semester Examinations Begin 8 a. m.
30 Friday—Memorial Day Recess

JUNE

6 Friday—Spring Semester Ends 5 p. m.
8 Sunday—Baccalaureate Day, Class Day
9 Monday—Commencement Day

SUMMER SESSIONS 1952

JUNE 1952

10 Tuesday—Registration for Inter-Session in a. m.
10 Tuesday—Inter-Session Classes Begin 1:20 p. m.
27 Friday—Inter-Session Ends
30 Monday—Registration for Main Summer Session

JULY

1 Tuesday—Main Summer Session Classes Begin 8 a. m.
4 Friday—Independence Day Recess

AUGUST

8 Friday—Main Summer Session Ends 5:50 p. m.
9 Saturday—Main Summer Session Graduation Exercises
11 Monday—Registration for Post-Session in a. m.
11 Monday—Post-Session Classes Begin 1:20 p. m.
29 Friday—Post-Session Ends 5:50 p. m.

CALENDAR

FALL SEMESTER 1952

SEPTEMBER 1952

11-13 Thursday to Saturday—Fall Semester Registration
15 Monday—Fall Semester Classes Begin 8 a. m.

NOVEMBER

25 Tuesday—Thanksgiving Recess Begins 5 p. m.

DECEMBER

1 Monday—Thanksgiving Recess Ends 8 a. m.
8-9 Monday and Tuesday—First Phase Registration for Spring Semester 1953
20 Saturday—Christmas Recess Begins 11:50 a. m.

JANUARY 1953

5 Monday—Christmas Recess Ends 8 a. m.
17 Saturday—Fall Semester Classes End 11:50 a. m.
19 Monday—Fall Semester Examinations Begin 8 a. m.
27 Tuesday—Fall Semester Ends 5 p. m.
27 Tuesday—Fall Semester Graduation Exercises

SPRING SEMESTER 1953

JANUARY 1953

29-31 Thursday to Saturday—Spring Semester Registration

FEBRUARY

2 Monday—Spring Semester Classes Begin 8 a. m.

APRIL

1 Wednesday—Spring Recess Begins 11:50 a. m.
8 Wednesday—Spring Recess Ends 1:10 p. m.

MAY

4-5 Monday and Tuesday—First Phase Registration for Fall Semester 1953
26 Tuesday—Spring Semester Classes End 5 p. m.
27 Wednesday—Spring Semester Examinations Begin 8 a. m.
30 Saturday—Memorial Day Recess

JUNE

5 Friday—Spring Semester Ends 5 p. m.
7 Sunday—Baccalaureate Day, Class Day
8 Monday—Commencement Day

COLLEGE ADMINISTRATIVE OFFICERS

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Ralph W. McComb, M.A. — *Librarian; Archivist*

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1951-1952

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R. WALLACE BREWSTER, M.A., Ph.D. *Professor of Political Science*
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Mabel Elizabeth Westgate, M.A. — *Associate Professor of Clothing and Textiles*
Ralph H. Wherry, M.A., C.L.U. — *Associate Professor of Insurance*
Delpha E. Wiesendanger, M.S. — *Associate Professor of Home Management and Housing*
Harold P. Zelko, M.A. — *Associate Professor of Public Speaking*
Margaret O. Zook, M.S., Ph.D. — *Associate Professor of Clothing and Textiles* (part-time)

ASSISTANT PROFESSORS

Ralph G. Ascah, Ph.D. — *Assistant Professor of Chemistry*
Francis A. Babione, M.A., Ph.D. — *Assistant Professor of Marketing*
Samuel P. Bayard, A.M. — *Assistant Professor of English Composition*
Joseph F. Bradley, M.A., Ph.D. — *Assistant Professor of Finance*
Nicholas M. Brentin, M.A. — *Assistant Professor of Romance Languages*
Barry S. Brinsmaid, M.A. — *Assistant Professor of Music*
Clara Cordelia Brong, M.A., Ph.D. — *Assistant Professor of Clinical Speech*
Ira V. Brown, M.A., Ph.D. — *Assistant Professor of History*
Howard Leon Carnahan, M.S., Ph.D. — *Assistant Professor of Agronomy*
Elton Stewart Carter, M.A., Ph.D. — *Assistant Professor of Speech*
George E. Ceiga, B.Mus. — *Assistant Professor of Music*
Robert E. Clark, M.A., Ph.D. — *Assistant Professor of Sociology*
Ray M. Conger, M.S. — *Assistant Professor of Physical Education*
Gilbert Leroy Crossley, E.E. — *Assistant Professor of Electrical Engineering*
Joseph Henry Dahmus, M.A., Ph.D. — *Assistant Professor of History*
Holle G. DeBoer, M.A. — *Assistant Professor of Public Speaking*
Norman C. Deno, M.S., Ph.D. — *Assistant Professor of Chemistry*
John A. DeNovo, M.A., Ph.D. — *Assistant Professor of History*
Bodie Eugene Douglas, M.S., Ph.D. — *Assistant Professor of Chemistry*
Charles Leonard Fergus, M.A., Ph.D. — *Assistant Professor of Botany*
Iline Fife, M.A., Ph.D. — *Assistant Professor of Speech*
Henry A. Finch, Ph.D. — *Assistant Professor of Philosophy*
Robert J. Flipse, M.S., Ph.D. — *Assistant Professor of Dairy Husbandry*
Henry R. Fortmann, M.S., Ph.D. — *Assistant Professor of Agronomy*
Aline H. Frink, M.A., Ph.D. — *Assistant Professor of Mathematics*
James J. Fritz, M.S., Ph.D. — *Assistant Professor of Chemistry*
Ila Gay Holsopple Gehman, M.Ed., D.Ed. — *Assistant Professor of Psychology*
Phyllis R. Griess, M.A., Ph.D. — *Assistant Professor of Geography*
Joseph H. Grosslight, M.A., Ph.D. — *Assistant Professor of Psychology*
George McRuer Guthrie, Ph.D. — *Assistant Professor of Psychology*
Oscar A. Haac, M.A., D.U.P., Ph.D. — *Assistant Professor of Romance Languages*
Julia M. Haber, M.A., Ph.D. — *Assistant Professor of Botany*
Edgar Brewer Hale, M.S., Ph.D. — *Assistant Professor of Poultry Husbandry and Psychology Research*
John F. Hall, M.A., Ph.D. — *Assistant Professor of Psychology*
Donald E. Hardenbergh, M.S. — *Assistant Professor of Engineering Mechanics*
Robert W. Higgins, Ph.D. — *Assistant Professor of Human Nutrition Research*

FLOYD A. HUMMEL, M.S. — *Assistant Professor of Ceramics*
THEODORE KENNETH KARHAN, M.Ed. — *Assistant Professor of Music and Music Education*
JOSEPH THADDEUS LAW, M.A. — *Assistant Professor of Political Science*
HENRY G. LEW, M.Ae.E., Ph.D. — *Assistant Professor of Aeronautical Engineering*
MORLEY G. MCCARTNEY, M.S., Ph.D. — *Assistant Professor of Poultry Husbandry*
NEIL A. MCNALL, M.A., Ph.D. — *Assistant Professor of History*
CHESTER T. MCNERNEY, M.S., Ph.D. — *Assistant Professor of Education*
VACLAV MARES, Ph.D. — *Assistant Professor of Economics*
JOHN W. MASLEY, M.A., D.Ed. — *Assistant Professor of Physical Education*
JOHN P. MILLER, Ph.D. — *Assistant Professor of Geology*
GERALD M. MOSER, Lic., D.U.P. — *Assistant Professor of Romance Languages*
EUGENE A. MYERS, M.A., Ph.D. — *Assistant Professor of Economics*
VERNON W. MYERS, M.A., Ph.D. — *Assistant Professor of Physics*
HAROLD ELROY NELSON, M.A., Ph.D. — *Assistant Professor of Speech*
AMOS EARL NEYHART, M.S. — *Administrative Head, Institute of Public Safety*
STUART PATTON, M.S., Ph.D. — *Assistant Professor of Dairy Manufacturing*
ROY P. PENNINGTON, Ph.D. — *Assistant Professor of Soil Technology*
THEODORE STEPHEN POLANSKY, M.S., Ph.D. — *Assistant Professor of Fuel Technology*
MARGARET C. RAABE, M.S. — *Assistant Professor of Clinical Speech and Speech Education*
ROBERT REIFSNEIDER, M.A. — *Assistant Professor of Dramatics*
J. W. CRANE REMALEY, M.S., Ph.D. — *Assistant Professor of Secondary Education*
NEAL RIEMER, M.A., Ph.D. — *Assistant Professor of Political Science*
H. DAVID RIX, M.S., Ph.D. — *Assistant Professor of Physics*
CHARLES W. RUTSCHKY, Ph.D. — *Assistant Professor of Entomology*
JOHN M. SCHEMPF, Ph.D. — *Assistant Professor of Chemistry*
ROBERT W. SCHIESSLER, M.S., Ph.D. — *Assistant Professor of Chemistry*
RUTH C. SILVA, A.M., Ph.D. — *Assistant Professor of Political Science*
CYRIL B. SMITH, M.Sc., Ph.D. — *Assistant Professor of Plant Nutrition*
WARREN S. SMITH, M.A. — *Assistant Professor of Dramatics*
LEO H. SOMMER, M.S., Ph.D. — *Assistant Professor of Chemistry*
WILLIAM SPACKMAN, JR., M.S., Ph.D. — *Assistant Professor of Paleobotany*
FRANK BRISCOE STEPHENS, M.S., Ph.D. — *Assistant Professor of Meteorology*
RICHARD G. STONER, A.M., Ph.D. — *Assistant Professor of Physics*
WERNER F. STRIEDIECK, A.M., Ph.D. — *Assistant Professor of German*
SHIOU-CHUAN SUN, M.S., Sc.D. — *Assistant Professor of Mineral Preparation*
ROBERT W. TAFT, M.S., Ph.D. — *Assistant Professor of Chemistry*
DAVID VAN METER, M.S. — *Assistant Professor of Electrical Engineering*
ALFRED FREDERICK WOELFEL, M.S. — *Assistant Professor of Electrical Engineering*
JAMES EVERETTE WRIGHT, JR., Ph.D. — *Assistant Professor of Genetics*
KELLY YEATON, M.A. — *Assistant Professor of Dramatics*
C. COURSON ZELIFF, M.S., Ph.D. — *Assistant Professor of Zoology*
HARRY D. ZOOK, M.S., Ph.D. — *Assistant Professor of Chemistry*

INSTRUCTOR

JAMES W. SHIGLEY, M.S., Ph.D. — *Instructor in Agricultural and Biological Chemistry*

THE GRADUATE SCHOOL

THE GRADUATE SCHOOL was established in 1922. Graduate instruction had been given previously under the direction of a committee of the faculty or of the College Senate. The School has general control of all questions concerning graduate work. The faculty consists of such members of the instructional staff as have immediate supervision of graduate courses.

In the Graduate School routine requirements are reduced to a minimum. So far as they exist, they are for the purpose of furnishing the discipline and methods necessary for independent study and investigation. It is the object of the School to surround the student with conditions that will enable him to devote himself to some chosen field. Advanced degrees are conferred as a mark of attainment of certain standards of scholarship.

The President of the College, on recommendation of the Dean of the Graduate School, will welcome Doctors of Philosophy of The Pennsylvania State College, as well as those of other accredited colleges and universities, as guests of the College, with the privilege of attending seminars and research courses and of carrying on research in laboratories and libraries. There will be no charge except for laboratory expenses. Arrangements should be made in advance with the Dean of the Graduate School.

ADMISSION—To be admitted to the Graduate School, an applicant must have received a baccalaureate degree from an accredited institution, earned under residence and credit conditions substantially equivalent to those required by this College. Graduates of The Pennsylvania State College must have had a minimum grade point average of 1.5 in their junior and senior years. Graduates of other institutions with different systems of grading must have had equivalent standing.

A student applying for admission, after having attended another graduate school where a substantial amount of credit has been earned, or a student whose career subsequent to graduation has been characterized by unusual attainments in fields having a bearing on his graduate qualifications, will be rated by a combination of the records submitted.

Admission is granted by the Dean of Admissions. If the applicant has attended more than one institution, an official transcript of the work covered at *each* institution is required. This applies to the complete academic record, both undergraduate and graduate. The applicant should have official credentials submitted directly from institutions to the Dean of Admissions as early as possible. A graduate of The Pennsylvania State College may present his final grade report or an official transcript of his complete record at the time he applies for admission to the Graduate School.

General inquiries regarding graduate work should be addressed to the Dean of the Graduate School. A student should not hesitate to write directly to the head of a department if he has specific questions regarding the work of that department.

CLASSIFICATION—At the time of admission all candidates must enroll as either *Regular* or *General* graduate students. The difference is as follows:

Regular Graduate Students (degree candidates)—This group includes all those who desire to become candidates for advanced degrees. Their complete status is determined and conditions of candidacy are arranged. A program is developed under the guidance of an adviser. A matriculation fee of $5 should accompany the application for admission.

General Graduate Students (nondegree candidates)—Applicants who meet all requirements for admission but who have not decided to become candidates for an advanced degree at this institution may arrange for a program of work as general graduate students. This classification is open to those who wish to transfer credit to another institution or who wish to fulfill requirements other than those of advanced degrees. An admission fee of $1 should accompany the application for admission.

The status and standing of a general graduate student will be reviewed by the Dean each time he reregisters. He may not remain a general graduate student longer than one semester (or summer sessions totaling 12 weeks) except with the permission of the Dean, and for definite, good reasons.

When a general graduate student wishes to become a regular graduate student, i.e., a candidate for an advanced degree at this institution, he should make application for change of status and should accompany his application with the $5 matriculation fee. His undergraduate record will then be re-evaluated to determine to what extent he may be prepared to undertake graduate work as a candidate for a degree in the major field of his choice as a regular student. He should understand that he may thereafter apply toward degree requirements only those credits earned as a general graduate student which fit logically into an integrated candidacy program. There is no guarantee that any such credits may be applicable.

REGISTRATION—Students in residence who are planning to take a program in the succeeding semester or in the summer session begin their registration at certain times announced for First Phase Registration. At these times resident graduate students are required to register just as undergraduates are.

The regular registration days for the completion of registration and for new students are indicated in the College Calendar. Graduate students are given one week for registration following the regular registration days before the late fee of $10 is imposed. Registration, including changes of program by drop-adds, must be completed within two weeks. These registrations apply to the academic year. Different regulations are applicable to the summer sessions. These are included in the summer sessions announcements.

A regular graduate student must prepare each term a program satisfactory to the major department, or advisory committee. A general graduate student must secure

departmental approval for each course scheduled. When the schedule bearing the approval of the adviser, or of a departmental representative, is signed by the Dean of the Graduate School, the student shall present himself at the office of the College Scheduling Officer and complete such forms as may be required. The payment of the required fees at the Bursar's office completes the registration.

Under certain conditions credit may be earned by work done off the campus. Students contemplating such work should inquire of the Dean of the Graduate School about the plans and conditions. Such work must be scheduled in advance in the regular manner.

Students must register for all graduate work—either course work or research, either in residence or off-campus, and for auditing courses—done while active candidates for degrees.

AUDITING OF COURSES—Students who have demonstrated their ability to do superior work while carrying normal graduate programs (which are determined by their status as full-time students, or as part-time students employed on the campus or elsewhere) may, with the approval of the Dean, register for "audits" in addition to their normal "credit loads." To secure such approval the student should present to the Dean written evidence that the instructor of the "audit course" will accept him as auditor, and that his adviser and the head of the department employing him (if he is employed) approve of the extra load.

CHANGES IN THE PROGRAM—When a change in program is essential, it may be made only with the approval of the Dean of the Graduate School. If the student should make a change in his major or in the degree toward which he is working, he would also be required to make such change through the office of the Dean of Admissions, and his status would be determined at that time. A fee of $2 is charged for each change of schedule.

CREDITS AND GRADES—All grades for graduate students are reported each term to the Registrar. Courses numbered in the 500 series are marked on the basis of P (pass), H (honors), or F (fail). For work taken in the 400 series a passing grade of 2 is required.

GRADUATE SCHOOL FEES

Matriculation fee (regular students)	$ 5.00
Admission fee (general students)	1.00
Incidental fee, each semester	50.00
General fixed fee, each semester	45.00
Health service fee (applicable to scholars, fellows, and graduate assistants)	7.50
Part-time fee, per credit (for less than 12 credits)	9.00
Late registration fee	10.00
Late payment or deferment fee	5.00
Change of schedule fee	2.00
*Graduation fee	10.00
Transcript of record (extra copy)	1.00
Off-campus registration fee, each year	2.50

Summer session students who register for graduate courses pay the regular fees for the summer sessions.

In addition to the above fees, all full-time students who are not residents of Pennsylvania are charged a tuition fee of $110 per semester; part-time students are charged an additional $9 per credit. There is no exemption from these fees, except for scholars, fellows, and graduate assistants.

Whenever it shall appear from any of the data presented as part of the application for admission that the applicant is not a resident of Pennsylvania, the Dean of Admissions, when admission is granted to that applicant, assumes that the one admitted is a non-Pennsylvanian. A student so admitted is held liable for the out-of-State tuition fee.

If the one who is admitted believes that his circumstances do not justify his classification as a non-Pennsylvanian, he may petition the Dean of Admissions for reclassification.

Whenever such a petition for reclassification is made, the petitioner is required to present proof of bona fide continuous residence of the one admitted (or his parents, if he is a minor) within the Commonwealth for a period of not less than 12 months immediately preceding his admission; and, in addition, such other evidence as may appear pertinent to a complete review of the classification.

* A charge of $1 is made for mailing the diploma to students who graduate in absentia.

CANDIDACY FOR ACADEMIC AND PROFESSIONAL DEGREES

In order to be admitted to candidacy for an advanced degree, the applicant must meet in full (1) the requirements for admission to the Graduate School, (2) certain undergraduate preparation necessary for the particular major chosen, and (3) a planned program approved by the major department.

ACADEMIC DEGREES

PREREQUISITE FOR CANDIDACY—Ample undergraduate preparation in the field in which the candidate intends to carry on graduate work is required. The number of undergraduate credits required varies in different departments. Full information as to what is considered adequate in the various fields is on file in the office of the Dean of Admissions. An applicant who is deficient in preparation may under certain conditions be admitted to the Graduate School but not to candidacy for a degree until he satisfies the requirements. This does not apply to a deficiency in the 1.5 scholastic average. If there is a deficiency in this regard, the applicant will be refused admission to the Graduate School. An applicant who has been admitted to the Graduate School but who lacks the required undergraduate credits for the major chosen will be allowed to follow a program satisfactory to the major department. It is likely that his program will require more than the minimum residence.

DEGREES OF MASTER OF ARTS AND MASTER OF SCIENCE

Two degrees are conferred, Master of Arts for those proceeding in the liberal arts, and Master of Science for those proceeding in science or technology.

REQUIREMENTS—A course for the master's degree requires a minimum of 30 credits and consists of one major and not more than two minor subjects. Choice of the major and minor subjects must be dependent upon adequate preparation. Except by permission of the Dean, one minor subject must be chosen in a field of study different from that of the major. The program requires the equivalent of one academic year (two semesters), and may be met by full-time residence, part-time work, attendance in the summer sessions, or by any combination of these. Students not adequately prepared, or assistants and other part-time students, will require more than this time to attain the master's degree. Three credits earned in residence at another approved institution or in the extension classes of The Pennsylvania State College under certain conditions may be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven summers.

At least 12 credit hours and a thesis equivalent of 6 credits must be devoted to the major subject. Twelve credits may be offered in courses open to upper-class and

graduate students (courses with 400 numbers). A student's program must be approved by the head of the major department and the Dean.

The mere completion of a stated amount of work does not entitle a candidate to recommendation for a degree. He must pass examinations upon such subjects and at such times as shall be designated by the departments concerned and must present an acceptable thesis.

THESIS—Under the direction of the department in which the candidate's major subject is taken, he must prepare a thesis upon a suitable topic related to that subject. Under certain conditions a student may be permitted to complete the thesis *in absentia.* To obtain such permission the student must make satisfactory arrangements both with the major department and with the office of the Dean.

For instructions concerning the form and the filing of typewritten copies of the thesis, see page 33.

DEGREE OF DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy (Ph.D.) is conferred in recognition of high attainments and productive scholarship in some special field of learning as evidenced (1) by the satisfactory completion of a prescribed period of study and investigation; (2) by the preparation of a dissertation involving independent research; and (3) by successfully passing examinations covering both the special subject and the general field of learning of which this subject forms a part.

RESIDENCE REQUIREMENTS—A minimum of three academic years of resident graduate study and research are required for the attainment of a doctor's degree. Students not devoting full time to graduate study will be required to extend their work over a longer period. Credit for part-time work will be based on the actual time spent in the pursuit of graduate work. Work of equal grade done in residence at other institutions and residence for a master's degree may be accepted by the Dean of Admissions and the faculty as partial fulfillment of the requirements, but at least one academic year must be spent at this institution. While the minimum residence requirements must be met, it is understood that the time requirement is secondary to other considerations.

One-third of the residence requirements for a Ph.D. degree may be met by research work away from the College in branch laboratories of the College, or research laboratories not connected with other degree-granting institutions, or in other centers where there are opportunities for research under the following conditions:

(a) The candidate shall have had at least one year's work in residence.
(b) The plan must have the approval of the group committee.
(c) Reports on the work shall be made as directed by the group committee.

A candidate for a doctor's degree, doing graduate work off the campus, may

obtain in this manner a maximum of six credits in an academic year, September to June, or nine credits in a calendar year. This does not apply to resident students temporarily assigned to other locations when, in the judgment of the Dean of the Graduate School, and the head of the department concerned, such assignment seems desirable.

Work done off the campus, which is to be credited toward a doctor's degree, must be scheduled *in advance* with the Dean of the Graduate School and the Dean of Admissions.

WORK DONE ELSEWHERE—Acceptance of residence in another institution as partial fulfillment of the requirements toward an advanced degree, shall be by authority of the Dean of Admissions. In determining to what extent the work done elsewhere may meet the course requirements at this institution each case will be decided on its merits by the group committee, or by the Dean and heads of the departments concerned.

PROGRAM OF WORK—A program shall consist of a major and one or two minor subjects. Two-thirds of the total time is to be devoted to the major subject. A division of the remaining one-third of the total time on the basis of two to one between the first and second minors is satisfactory. The heads of the major and minor departments or their representatives, together with the Dean, constitute a special group committee which shall have general charge of the arrangement of the program.

For the first year of graduate study leading to the doctor's degree, 30 credit hours is considered a full-time program. The first year's work may be substantially the same as that provided for the master's degree, and may lead to that degree, although that is not necessary.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department that he is prepared to proceed and is recommended by his group committee.

There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. A program shall consist of such a combination of courses and research as is approved by the group committee for each individual student. Students devoting only a portion of their time will be credited on their residence requirements in proportion to the time actually spent in graduate study and research.

DISSERTATION—The ability to do independent research must be proved by the preparation of a dissertation on some topic in connection with the major subject. It should represent a contribution on some worth-while problem presented in a scholarly manner. The contents and conclusions of the dissertation must be defended at the time of the final examinations.

The general subject of the dissertation must be determined at the time of admission to candidacy for the degree, and the completed dissertation, typewritten in triplicate copy, must be filed in the office of the College Librarian not later than one week prior to the commencement at which the candidate expects to take the degree.

For regulations concerning the form and the filing of the dissertation, see page 33.

EXAMINATIONS—Preliminary or qualifying examinations are required in the major and minor subjects to determine whether the candidate has made satisfactory progress and is entitled to the privilege of completing the requirements for the degree. These examinations must be scheduled at a time when at least one-third of the residence requirements remain to be satisfied. They are given by a committee representative of the departments concerned and such other members as the Dean may appoint. The candidate must have satisfied the language requirements before taking the preliminary examinations.

For the Doctor of Philosophy degree, candidates are required to have a reading knowledge of at least two foreign languages. German and French are the languages most often needed. Other languages may be presented instead of these if their choice is determined by scholarly and professional reasons. The choice of a language must be approved by the major department. If a language other than English, French, German, Italian, Spanish, or Russian is presented, it must be approved also by the Dean of the Graduate School. A student may not present his mother tongue as one of the two languages required in candidacy. Certificates of proficiency must be obtained from the respective language departments of this College, or from the Dean of Admissions provided language requirements have been met at another institution. Candidates not presenting certification of reading ability at the time of admission should make immediate arrangements to acquire that ability either through class work or by tutoring. The language requirements must be satisfied prior to the scheduling of the preliminary examinations. The language examinations will be administered three times each year, ordinarily between 7 and 9 p. m. on the first Monday in November, the first Monday in March, and the Monday of the fifth week of the regular Summer Session. Registration for the examinations must be completed in the respective departments no later than one month prior to the date of the examinations.

The final examination for the doctor's degree is conducted by a committee representative of the departments concerned and such other members as may be appointed by the Dean, who shall also designate the time and place. The examination is oral, open to the public, and covers the whole field of study of the candidate without regard to courses that may have been taken either here or elsewhere.

PROFESSIONAL DEGREES IN EDUCATION

PREREQUISITES FOR CANDIDACY—In order to provide graduate work which would utilize more fully the professional training and background of those holding bachelors' degrees from teachers colleges and schools of education, these professional degrees in education were established.

All candidates are required to have had at least 27 undergraduate credits in the field of education, including practice teaching. If a candidate elects to specialize in a subject-matter field, then certain additional prerequisites are required for that subject. The amount of preparation varies in the different fields. Full information concerning the preparation required by the various departments is on file in the office of the Dean of Admissions. If there are deficiencies at the time of admission they must be removed before candidacy for a degree is completed. While making up deficiencies in prerequisite credits a student must follow a program satisfactory to the major department. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School.

Candidates for the advanced degrees in education are required to take a qualifying comprehensive examination before completing the second half of their course requirements, which serves as a guide in outlining a program of study that will meet the individual needs of the candidate.

DEGREE OF MASTER OF EDUCATION

The degree of Master of Education represents general scholarship, acquaintance with the chief phases of educational literature, teaching skill, qualities of leadership in educational work, and ability to solve concrete problems in at least one special field of education.

The following regulations govern candidacy for the degree of Master of Education:

RESIDENCE AND COURSE REQUIREMENTS—A minimum of 30 credits, 6 of which may be granted for an approved thesis. The program requires the equivalent of one academic year (two semesters) and may be met by full-time residence, part-time work, attendance in the summer sessions, or any combination of these. Three credits earned in residence at another approved institution or in extension classes of The Pennsylvania State College, under certain conditions may be offered as partial fulfillment of the requirements. All requirements must be met within six years, or a period spanning seven summers.

A minimum of 24 credits is to be earned in graduate course work. It is expected that the larger part of this work shall be in courses open only to graduate students, but the needs of the student shall be considered in arranging the best combination of courses (400 and 500 series) for the preparation of the candidate in his special field.

If a student looks forward to a career as a teacher, he may specialize in a specific field (as English, mathematics, Latin, etc.), and that shall be regarded as the major field, and a majority of the work is to be taken there. If a broader field is sought, a group major may be chosen (as social studies, general science, etc.). In this case a larger percentage of the 24 credits is to be devoted to the subjects forming the group major. The remainder of the program is devoted to a minor in the field of education, consisting of approximately one-third of the required credits, depending on the previous preparation, experience, and objectives of the candidate. In case the candidate's undergraduate preparation has not included courses in the scientific study of education and advanced educational psychology, a course in each of these fields must be included.

Those desiring to prepare as supervisors and administrators may choose a major and a minor within the curricula of Education. The following fields are recommended: secondary school principal, elementary school principal, superintendent of schools, guidance counselor, vocational director, or supervisor.

The candidate may choose one field of work for a major and another field for a minor. These majors prepare for State certificates in those fields where special certificates are given. It is possible to arrange programs of study concentrated in other fields.

ADVISORY COMMITTEE—When the major is in a specific field the heads of the major and minor departments or fields (or their representatives) together with the supervisor of the problem course (thesis) constitute a special advisory committee which shall approve the study program. In practice the general guidance of a student is centered in an adviser from the major department, who is familiar with the field in which the student is specializing.

When the student chooses a group major his study program will be approved by a standing committee (or its representatives), which committee will foster the student's interests and stand in the same relation to him as does a department in the case of a student with a specific major. Such standing committees have been appointed in the broad fields of biological science, physical science, and social studies.

THESIS—Under the direction of a supervisor representing either a major department or a standing committee supervising group majors, an amount of time equivalent to six credits may be devoted to problem work and the preparation of a thesis. Under certain conditions this may be carried out in part *in absentia,* particularly when requirements are met by summer session attendance.

Course work may, under certain conditions, wholly or in part, take the place of the problem and thesis work. Application for the opportunity to substitute six credits of course work for the thesis must be filed with the candidate's advisory committee or adviser before the candidate completes more than 12 of the 30 credits required for the degree. The application must include the statement of the major and the titles and numbers of the courses which the candidate wishes to submit in substitution for the thesis.

For instructions concerning the form and the filing of the thesis, see page 33.

EXAMINATIONS—Candidates for the Master of Education degree must pass a final comprehensive examination. The examination will be designed to determine the ability of the candidate to apply the general, as well as the special, knowledge of his chosen field in practical situations.

DEGREE OF DOCTOR OF EDUCATION

The degree of Doctor of Education is conferred in recognition of scholarship and teaching or administrative skill as evidenced by (1) the satisfactory completion of a prescribed period of study, (2) the application of scientific principles in classroom teaching, in the supervision of instruction, or in administrative work, (3) by the preparation of a dissertation demonstrating ability to attack an educational problem with originality and independent thought, (4) by successfully passing examinations showing a satisfactory grasp of the field of specialization and its relation to allied subjects, and (5) by recognized leadership in the profession of education.

RESIDENCE—An equivalent of three years of graduate study is required as a minimum for the doctor's degree. However, it is not required that the three years be continuous. Graduate study may be carried on through a longer period and paralleled by teaching or administrative work.

Work of equal grade done in residence at other institutions, and residence for a master's degree, may be accepted as partial fulfillment of the requirements, but in addition at least one academic year or its equivalent must be spent in residence at this institution. For students pursuing work beyond the master's degree a combination of sessions amounting to at least 30 weeks is regarded as the equivalent of an academic year. While it may be possible to fulfill the minimum residence requirement as just stated, it is expected that candidates for the doctorate will be taking a much greater amount of work in the institution. Those completing requirements in summer sessions will continue during the regular school year in some educational situation, under the guidance of members of the faculty, study and research programs set up in summer courses.

One-third of the requirements (equivalent to a 30-credit year) for the degree of Doctor of Education may be met by research work pursued away from the campus in the school systems of the State, or in other approved centers not connected with degree-granting institutions, provided (1) the plan be approved by the student's advisory committee, (2) reports on the projects be made as directed by the advisory committee, (3) not more than six credits be earned in an academic year, September to June, or nine credits in a calendar year.

Work done off the campus, which is to be credited toward a doctor's degree, must be scheduled *in advance* with the Dean of the Graduate School and the Dean of Admissions.

PROGRAM OF STUDY—The program of study shall be so arranged as to lead toward high professional mastery within some area of educational service. A majority of the courses offered in fulfillment of the requirement will be in the major field of

study. The remainder shall be in one or two minors bearing some functional relation to the major and to the work the candidate is planning to do.These minors may be in academic subjects or in some phase of education or psychology other than the major. In the case of persons intending to continue in classroom teaching rather than in administrative or supervisory positions, a larger proportion of the work may be assigned to the academic fields in which the candidate is teaching, to whatever extent the advisory committee may believe the background and the objectives of the particular candidate warrant. But every candidate for the degree of Doctor of Education must show through a comprehensive examination that he is familiar with current theories of education; that he understands and can apply the techniques and the findings of educational research so far as they bear upon the teaching of his subject; that he is prepared to read understandingly, and to contribute to, the technical professional literature in his field; and that he can criticize his own procedures in the light of historical trends and practices in this and other countries.

Command of the tools for a thorough study of the problems of education is necessary and must include familiarity with statistical methods. For certain students the requirements may include a reading knowledge of one or more foreign languages.

There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The general requirements are based not upon courses or credits but upon a definite residence, a satisfactory dissertation, the passing of a comprehensive examination, and possession of the qualities of professional leadership. A program shall consist of such a combination of courses and individual study and research as is approved by the advisory committee for each student.

ADVISORY COMMITTEE—The heads of the major and minor departments or fields (or their representatives), the supervisor of the dissertation, together with the Dean of the Graduate School, constitute a special advisory committee which shall have charge of the arrangement of the study program.

DISSERTATION—Evidence of a high degree of scholarship and ability to select, organize, and apply knowledge must be presented by the candidate in the form of a written dissertation. The candidate must demonstrate capacity for independent thought and ability and originality in the application of educational principles or in the development of new generalizations under scientific controls. The topic and outline of the proposed thesis must have the approval of the advisory committee.

For instructions concerning the form and filing of the dissertation, see page 33.

EXAMINATION AND ADMISSION TO CANDIDACY—In order to be admitted to full candidacy for the degree each candidate shall pass preliminary qualifying examinations administered by the committee on qualifying examinations. The qualifying examinations may not be taken until after one semester of work has been completed at this institution. They must be scheduled at a time when at least one-third of the residence requirements remain to be satisfied. Examinations will be held at times arranged with the head of the major department. The qualify-

ing examinations will be designed to test (1) the candidate's general scholastic preparation and professional background; and (2) his ability to integrate and apply his knowledge in his fields of specialization to practical situations so as to reflect an intelligent mastery of the subjects.

Three of the important factors taken into consideration in passing judgment upon the application of a candidate for admission to candidacy are:

(a) Previous scholastic record at this institution and other institutions attended;

(b) Achievement in qualifying examinations;

(c) Estimates of his personal and professional qualifications by members of the advisory group.

The advisory committee will make recommendations to the Dean of the Graduate School, and the candidates will be advised of the decision with regard to their applications for candidacy within 10 days following the date of each qualifying examination.

A candidate who has fulfilled all other requirements for the degree will, on recommendation of his advisory committee, be permitted to take the final oral examination for the degree. The committee in charge of this examination will consist of the student's advisory committee and others appointed by the Dean of the Graduate School. The examination will be based upon the dissertation and related problems. Arrangements for taking the final examination must be made with the Dean of the Graduate School, through the advisory committee and the major department, not later than two weeks prior to a commencement date.

PROFESSIONAL DEGREE IN FORESTRY

The degree of Master of Forestry represents scholastic ability, acquaintance with forestry literature, and technical knowledge of one or more of the several specialized fields in forestry or wood utilization. It is offered to provide an opportunity for additional study in a student's particular field of interest, rather than for research work on a special problem, though such work is not precluded under the requirements for the degree.

PREREQUISITES FOR CANDIDACY—A candidate is required to hold a baccalaureate degree, or its equivalent, from a recognized professional school of forestry. Full information concerning the preparation required in either general forestry or wood utilization is on file in the office of the Dean of Admissions. If there are deficiencies at the time of admission they must be removed before candidacy for a degree is completed. While making up deficiencies in prerequisite credits, the student must follow a program approved by his advisory committee. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School.

RESIDENCE AND COURSE REQUIREMENTS—A minimum of 30 credits is required for the degree of Master of Forestry. These credits are to be taken in the best arrangement of courses bearing 400 and 500 numbers suited to the needs of

the individual student. Although not required, a maximum of 6 credits may be assigned to a thesis upon approval and recommendation of the head of the Forestry Department. All requirements must be met within six years, or a period spanning seven summers.

A maximum of three credits may be earned in extension classes of The Pennsylvania State College, or in resident classes of other approved institutions, provided these credits have the approval of the Dean of Admissions and fit into the program of the student.

A student should choose one field of work for his major interest with one or two related minor fields. The proportion of credits to be taken in the major and minor fields of study will be determined in consultation with an advisory committee. Ordinarily this committee consists of the head of the Forestry Department and the professors in charge of the major and minor fields.

TECHNICAL DEGREES

ADMISSION—A graduate of the School of Chemistry and Physics, of the School of Engineering, or of the School of Mineral Industries of The Pennsylvania State College may be admitted to candidacy for a technical degree, provided he submits evidence of having been engaged for a period of not less than three years in acceptable professional work in the field of engineering in which the application for the degree is made.

A technical degree may also be granted to an engineer of approved practical experience who is a graduate in engineering of another institution of equal standing, on completion of at least three years of full-time teaching or research work in engineering in a professorial rank in this institution and upon presentation of an acceptable thesis and the fulfillment of all other requirements for technical degrees. An applicant who is eligible for a technical degree is admitted to the Graduate School by the Dean of Admissions.

REGISTRATION—A candidate for a technical degree must file with the Dean of Admissions an application filled out in duplicate on the prescribed forms, approved by the head of the department in which the undergraduate work was completed. The application should be accompanied by the matriculation fee of $5.

Registration for these degrees is the same as for resident students. A candidate must be registered during two regular semesters.

DEGREES AND REQUIREMENTS—The technical degrees are as follows: Aeronautical Engineer, Architectural Engineer, Chemical Engineer, Civil Engineer, Electrical Engineer, Fuels Engineer, Industrial Engineer, Ceramic Engineer, Mechanical Engineer, Engineer of Mines, Metallurgical Engineer, Petroleum Engineer, and Sanitary Engineer.

Not less than three years shall have elapsed from the time of receiving the first degree before a graduate of this institution shall be permitted to file his application

for a technical degree. The application for a technical degree shall include evidence of a satisfactory professional record, which must be approved by the executive committee of the undergraduate School concerned.

In order to be recommended for a technical degree the candidate must prepare a thesis on a subject related to his profession. He must register in the manner specified in the foregoing paragraph and pay the registration and diploma fees. He may be required to appear in person to defend his thesis.

THESIS—Immediately following registration the candidate must submit for approval an outline of his proposed thesis, and at least six weeks prior to the day on which the degree is to be conferred, the complete thesis must be in the office of the head of the department concerned.

For regulations concerning the form and filing of the thesis, see below.

FEES—Each candidate for a technical degree must pay a matriculation fee of $5 and a diploma fee of $10 when recommended to the College Senate for the degree. Fees are payable by check drawn to the order of The Pennsylvania State College. The matriculation fee is sent to the Dean of Admissions, the diploma fee to the Bursar.

REGULATIONS FOR THESES AND DISSERTATIONS

It is required that three typewritten copies of theses and dissertations be presented. They are due in the office of the College Librarian not later than one week prior to the day on which the degree is to be conferred.

Before arranging for the typing, the candidate must obtain information from the College Librarian concerning the format, paper, illustrations, etc.

A thesis for a master's or a technical degree thus submitted and approved becomes wholly the property of the College and may not be published, in whole or in part, without authorization of the author and the professor who supervised the candidate's research.

A candidate for a doctor's degree must satisfy also one of the following requirements as to the dissertation not later than one week prior to the day on which the degree is to be conferred:

1. Publication of the dissertation in a manner satisfactory to the College Librarian and deposit of 100 copies in the College Library; or

2. Presentation of a typewritten abstract, satisfactory to the major department and the College Librarian and the sum of $35. The Librarian will then arrange for the printing of the abstract. Fifty copies of the printed abstract will be furnished to the candidate without additional cost.

GRADUATE ASSISTANTSHIPS AND OTHER AIDS

A number of appointments as assistants in teaching or research work, or awards as fellows, or scholars, are available with varying stipends and exemption from the incidental fee, the general fixed fee, and the out-of-State tuition fee. A health service fee of $7.50 is assessed, from which there is no exemption. The application for appointment should be made to the head of the department in question. The graduate program that can be carried is proportioned to the service rendered.

GRADUATE ASSISTANTSHIPS—Quarter Time. Appointments for 9 months, September 16 to June 15 (stipend $510), or for the fiscal year (stipend $672); service one-fourth time; program four-fifths.

GRADUATE ASSISTANTSHIPS—Half Time. Appointments for 9 months, September 16 to June 15 (stipend $1010), or for the fiscal year (stipend $1344); service one-half time; program two-thirds.

GRADUATE ASSISTANTSHIPS—Three-Quarters Time. Appointments for 9 months, September 16 to June 15 (stipend $1520), or for the fiscal year (stipend $2016); service three-fourths time; program one-half.

DU PONT FELLOWSHIP IN CHEMISTRY—Candidate recommended by the Department of Chemistry and approved by a member of the fellowship committee of the du Pont Company (stipend $1200 minimum).

RESEARCH AND INDUSTRIAL FELLOWSHIPS—Numerous fellowships offered by various outside agencies for the investigation of special problems (stipends vary). Information is obtainable from the departments.

THE JOHN W. WHITE FELLOWSHIP—Awarded to one graduate of The Pennsylvania State College each year on the basis of scholarship, need, character, and attitude.

THE ELLIOTT FELLOW IN ENGINEERING RESEARCH—An annuity provided by W. S. Elliott, of Pittsburgh, for a student in engineering who must be a graduate of this College.

GRADUATE SCHOLARSHIPS—A limited number of scholarships without stipends, but with exemption from the incidental, general fixed, and out-of-State tuition fees, are assigned to the various departments. The holders are required to render some service and take a full program of graduate work. Application may be made to the Dean of the Graduate School or to the head of the department in question.

GRADUATE COURSES

NUMBERING SYSTEM

The course descriptions which follow are arranged alphabetically. If any course cannot be located readily, refer to the table of contents, pages 2 and 3. Courses are numbered as follows:

UNDERGRADUATE COURSES, numbered 1 to 399, are general courses accepted in fulfillment of the requirements for the bachelor's degree.

UPPER-CLASS AND GRADUATE COURSES, numbered 400 to 499, are advanced courses open for credit to undergraduate students of at least junior standing and to graduate students under the restriction that no more than 12 credits in these courses may be offered in fulfillment of the requirements for the M.A. and M.S. degrees.

GRADUATE COURSES, numbered 500 to 599, are for graduate students only. The name of the instructor may follow the description. Seniors not required to carry a full program for graduation, with permission of the Dean of the School in which they are enrolled and of the Dean of the Graduate School, may attend such courses and be allowed credit under special conditions. *Many departments reserve the right to say which of certain graduate courses may be given in any semester; the heads of departments should be consulted.*

The figures in parentheses following the course title show the number of credits granted for that course. Many graduate courses are offered in the summer sessions. When these courses are also given during the regular academic year, they are not listed separately as summer session courses in this announcement. For a complete list of courses given during a specific summer session, consult the *Complete Announcement of the Summer Sessions* for that year. In the section which follows, courses given during the summer session (*but not during the regular academic year*) have numbers followed by the letter "S." Courses given in extension only have numbers followed by the letter "X."

AERONAUTICAL ENGINEERING

PROFESSOR DAVID J. PEERY, M.S.E., C.E., Ph.D.
Head of the Department

AERO.E. 500. THESIS (1-9)

AERO.E. 501. AIRPLANE STABILITY AND CONTROL (3) General analysis of longitudinal and lateral stability of airplanes; characteristics of flight control devices. Prerequisite: Aero.E. 403.

AERO.E. 503. AIRPLANE PERFORMANCE (3) Methods of performance prediction and performance flight testing for high-speed aircraft and missiles. Prerequisite: Aero.E. 403.

AERO.E. 504. ROTARY WING AIRCRAFT (3) Types of rotary wing aircraft; helicopter performance, stability, and control; structural and vibration problems. Prerequisites: Aero.E. 403, 409.

AERO.E. 505. AIRCRAFT VIBRATION AND FLUTTER (3) Vibrating systems with several degrees of freedom; analysis of flutter speed of an airplane wing considering bending, torsion, and aileron motions; other types of aircraft flutter. Prerequisites: Aero.E. 1, M.E. Des. 8. *Professors Peery and Lew*

AERO.E. 506. ADVANCED AIRCRAFT STRUCTURES (3) Deflections of beams and trusses; statically indeterminate structures; shear-flow analysis and shearing deformations of multi-cell semi-monocoque structures; effects of discontinuities in wing and fuselage structures. Prerequisite: Aero.E. 409. *Professor Peery*

AERO.E. 507. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3) Types of jet propulsion installations, thermodynamic cycles, analysis of compressors, combustion chambers, and turbines. Prerequisite: Aero.E. 410. *Professor Lessen*

AERO.E. 510. AERODYNAMICS OF COMPRESSIBLE FLUIDS (3) One-dimensional motion, shock waves, flow in nozzles, two-dimensional flow, airfoil theory, Prandtl-Meyer flow, method of characteristics. Prerequisites: Aero.E. 412, M.E. 2. *Professors Lessen and Lew*

AERO.E. 511. AERODYNAMICS OF A PERFECT FLUID (3) Euler's dynamic equations, complex potential, conformal transformation, thin airfoils, Biot-Savart law; Prandtl three-dimensional airfoil theory. Prerequisite: Aero.E. 412. *Professor Lew*

AERO.E. 512. AERODYNAMICS OF A VISCOUS FLUID (3) Navier-Stokes equations, incompressible and compressible boundary layer theory, jet and wake problems, hydrodynamic stability, turbulence. Prerequisite: Aero.E. 412. *Professor Lessen*

AERO.E. 513. RESEARCH IN AERONAUTICAL ENGINEERING (1-15 per semester) Investigation of a theoretical or experimental project in aeronautical engineering.

AERO.E. 514. AERONAUTICAL ENGINEERING SEMINAR (1 per semester) Current literature and special problems in aeronautical engineering.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AERO.E. 401a,b,c. AERONAUTICAL ENGINEERING PROJECTS (2-12)
AERO.E. 402. AIRPLANE ENGINE DESIGN (4) *Professor Lessen*
AERO.E. 403. APPLIED AERODYNAMICS (3) *Professor Lew, Mr. Howells*
AERO.E. 404. AIRPLANE DESIGN (4) *Mr. Howells*
AERO.E. 407. ROTARY WING AIRCRAFT (3)
AERO.E. 408. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3) *Professor Lessen, Mr. Duke*
AERO.E. 409. AIRPLANE DETAIL DESIGN (3) *Mr. Fox*

AERO.E. 410. AIRCRAFT PROPULSION (3) *Mr. Duke*
AERO.E. 411. AIRCRAFT STRUCTURES (3) *Professor Peery, Mr. Fox*
AERO.E. 412. THEORETICAL AERODYNAMICS (3) *Professor Lew, Mr. Fox*
AERO.E. 413. GUIDED MISSILES (3) *Mr. Howells*

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

PROFESSOR HOWARD O. TRIEBOLD, M.S., Ph.D.
Acting Head of the Department

AGR. BIOCHEM. 501. ENZYMES (2) Investigations and theories concerning nature of enzymes, enzyme action, influence of chemical environment on enzyme action, and biological applications. Prerequisite: Agr. Biochem. 437. *Professor Jensen*

AGR. BIOCHEM. 502. PHYSICAL CHEMISTRY OF THE CELL (3) Lectures and assigned reading reviewing current literature relative to physical chemistry of living tissues and life processes. Prerequisite: Agr. Biochem. 426. *Professor Lisse*

AGR. BIOCHEM. 503. RESEARCH (3-15) The prosecution of an assigned problem under the guidance of an instructor. Prerequisite: Agr. Biochem. 417. For certain problems additional courses may be considered as prerequisite.

AGR. BIOCHEM. 504. THESIS RESEARCH (3-15 per semester) Continuation of Agr. Biochem. 503.

AGR. BIOCHEM. 505. VITAMINS AND DIETARY DEFICIENCY DISEASES (2) Lectures, conferences, and assigned reading. Prerequisite: Agr. Biochem. 437.

AGR. BIOCHEM. 506. VITAMIN ASSAY METHODS (2) Lectures, conferences, and demonstrations dealing with approved methods of vitamin assay and including demonstrations of typical vitamin deficiency syndromes in the rat. Prerequisite: Agr. Biochem. 505. *Professor Guerrant*

AGR. BIOCHEM. 507a. SEMINAR IN PHYSIOLOGICAL CHEMISTRY AND NUTRITION (1) *Professors Guerrant, Anderson, Boucher, Miller, and Pritham*

AGR. BIOCHEM. 507b. SEMINAR IN FOODS AND ANALYTICAL CHEMISTRY (1) *Professors Triebold and Althouse*

AGR. BIOCHEM. 507c. SEMINAR IN PLANT, SOIL, AND INSECTICIDE CHEMISTRY (1) *Professors Frear and Jensen*

AGR. BIOCHEM. 508. RESEARCHES IN PLANT CHEMISTRY (3) Lectures and assigned readings reviewing the more important chemical investigations in plant chemistry. Prerequisite: Agr. Biochem. 437. *Professor Jensen*

AGR. BIOCHEM. 509. BIOCHEMICAL METHODS (3) An advanced laboratory course involving special methods used in biochemical research on plant and animal materials. Prerequisite: Agr. Biochem. 437. *Professor Anderson*

AGR. BIOCHEM. 510. PROTEINS (2) The chemical constitution of proteins, their physical and biochemical properties, their function in nutrition, and their fate in metabolism. Prerequisite: Agr. Biochem. 437. *Professor Anderson*

AGR. BIOCHEM. 511. CARBOHYDRATES (2) Study of research work dealing with the carbohydrates and their metabolism in the plant and animal organisms. Prerequisite: Agr. Biochem. 437. *Professor Jensen*

AGR. BIOCHEM. 512. LIPIDS (2) Investigations on the biochemistry of fats and related substances. Prerequisite: Agr. Biochem. 437. *Professor Triebold*

AGR. BIOCHEM. 513. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (4) Laboratory course, quantitative in nature, valuable as preparation for Agr. Biochem. 502. Hydrogen-ion concentration, electrometric titration, buffers, oxidation-reduction potential, and membrane potential. Prerequisite: Agr. Biochem. 425 or Chem. 41, 43. *Professor Lisse*

AGR. BIOCHEM. 515. BIOMETRY (2) The application of statistical methods to research problems in biochemistry and biology. Prerequisites: Agr. Biochem. 437, Math. 30. *Professor Miller*

AGR. BIOCHEM. 516. CHEMISTRY OF INSECTICIDES AND FUNGICIDES (2) Lectures and assigned readings dealing with chemical investigations of materials used in the control of insects and plant diseases. Prerequisites: Chem. 30, 31; Agr. Biochem. 425 or Chem. 41, 43; Agr. Biochem. 417. *Professor Frear*

AGR. BIOCHEM. 517. ENDOCRINE SECRETIONS (2) Chemistry of hormones and their physiological significance. Prerequisite: Agr. Biochem. 437. *Professor Pritham*

AGR. BIOCHEM. 518. MINERAL METABOLISM (2) Utilization and function of the mineral elements in animal nutrition. Prerequisite: Agr. Biochem. 437. *Professor Boucher*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. BIOCHEM. 403. DAIRY CHEMISTRY (3) *Professor Triebold*
AGR. BIOCHEM. 404. FOOD CHEMISTRY (4) *Professor Triebold*
AGR. BIOCHEM. 413. PRINCIPLES OF ANIMAL NUTRITION (3) *Professor Miller*
AGR. BIOCHEM. 417. METHODS OF AGRICULTURAL ANALYSIS (4) *Professor Triebold*
AGR. BIOCHEM. 418. PLANT ANALYSIS (4) *Professor Jensen*
AGR. BIOCHEM. 421. CHEMISTRY OF MILLING AND BAKING (3) *Professor Triebold*
AGR. BIOCHEM. 425. BIOPHYSICAL CHEMISTRY (4) *Professor Lisse*
AGR. BIOCHEM. 426. BIOCOLLOIDS (3) *Professor Lisse*
AGR. BIOCHEM. 427. POTENTIOMETRIC THEORY AND TECHNIQUE (3) *Professor Lisse*
AGR. BIOCHEM. 437. GENERAL BIOCHEMISTRY (5) *Professor Pritham*
AGR. BIOCHEM. 438. PHYSIOLOGICAL CHEMISTRY (CLINICAL METHODS) (5) *Professors Anderson and Pritham*
AGR. BIOCHEM. 439. PROBLEMS IN AGRICULTURAL CHEMISTRY (3-5)
AGR. BIOCHEM. 440. PLANT BIOCHEMISTRY (3) *Professor Jensen*

AGRICULTURAL ECONOMICS

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.
Head of the Department of Agricultural Economics and Rural Sociology

AGR. EC. 500. SEMINAR IN AGRICULTURAL ECONOMICS (1-6) A review of current literature and problems.

AGR. EC. 502. ECONOMIC PROBLEMS IN THE MARKETING OF FRUITS AND VEGETABLES (3) *Professor Lee*

AGR. EC. 503. RESEARCH METHODS IN FARM MANAGEMENT (1-3) Evaluation of research procedures, methods, results, and needs in the field; emphasis on their application to specific research problems. Prerequisites: Agr. Ec. 6, Econ. 14. *Professor Barr*

AGR. EC. 504. AGRICULTURAL PRICE AND INCOME POLICY (3) Analysis of farm prices, income consequences for producers and consumers, and effects on resource use; evaluation of policy, considerations in policy making. Prerequisites: Agr. Ec. 420, Econ. 405. *Professor Brandow*

AGR. EC. 505. ADVANCED AGRICULTURAL STATISTICS (3) Multiple correlation, curve fitting, analysis of variance, selection of samples, and other techniques applicable to the rural social sciences. Prerequisite: 3 credits in statistics. *Professor Brandow*

AGR. EC. 507. SEMINAR IN FARM MANAGEMENT (1-6) Special problems relating to the organization and operation of the farm business. Prerequisites: Agr. Ec. 6, Econ. 14.

AGR. EC. 515. ECONOMIC PROBLEMS IN THE MARKETING OF DAIRY PRODUCTS (3) Economic problems as they are encountered in the process of marketing; particular attention to governmental regulation in pricing and marketing. *Professor Pierce*

AGR. EC. 517. PROBLEMS AND POLICIES OF FARMER CO-OPERATIVES (3) Specific types of co-operative organizations, their problems, policies, and progress; relationships existing among co-operatives, between co-operatives and other business organizations, and between co-operatives and the public. Prerequisite: Agr. Ec. 17. *Professor Becker*

AGR. EC. 522. ADVANCED FARM APPRAISAL (3) Land value theory; methods of land valuation; field practice in farm appraisal. Prerequisite: Agr. Ec. 6.

AGR. EC. 525. RESEARCH METHODS IN RURAL SOCIAL SCIENCES (2) Scientific method in planning and conducting research. Prerequisite: 9 credits in social sciences. *Professor John*

AGR. EC. 533. ECONOMIC PROBLEMS IN THE MARKETING OF POULTRY AND EGGS (3) Detailed treatment of special problems such as the marketing of particular types and grades of products, the operation of certain markets, and the performance of selected marketing functions. Prerequisites: Econ. 14, P.H. 1. *Professor Baker*

AGR. EC. 540. THESIS IN AGRICULTURAL ECONOMICS (6) The preparation of the required thesis for the degree of Master of Science in agricultural economics while in residence at the College.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. EC. 400, 400X. PUBLIC POLICIES IN AGRICULTURE (1-2)
AGR. EC. 404. FARM FINANCE (2) *Professor Miller*
AGR. EC. 405. STATISTICS APPLIED TO THE RURAL SOCIAL SCIENCES (3) *Professor Brandow*
AGR. EC. 407. ADVANCED FARM MANAGEMENT (3) *Professor Miller*
AGR. EC. 420. AGRICULTURAL PRICES (3) *Professor Brandow*
AGR. EC. 421. LAND ECONOMICS (3) *Professor Frey*
AGR. EC. 430. ECONOMIC CHARACTERISTICS OF FOOD AND AGRICULTURE (3)

AGRICULTURAL EDUCATION

PROFESSOR HENRY S. BRUNNER, M.S., Ph.D.
Head of the Department

AGR. ED. 501v. HISTORY OF AGRICULTURAL EDUCATION (1-3) Development of training for agricultural vocations; emphasis upon introduction of agricultural instruction into the high school program. *Professor Hall*

AGR. ED. 502v, 502vX. TEACHING VOCATIONAL AGRICULTURE (1-3) Organization of instruction with respect to vocational objectives, methods of presentation, supervision of practice, pupil evaluation of goals, and follow-up.

AGR. ED. 503v, 503vX. RESEARCH IN AGRICULTURAL EDUCATION (1-6 per semester) Individual study problems in various phases of agricultural education, such as evaluation of teaching, teaching procedures, and teacher preparation. *Professor Brunner and Staff*

AGR. ED. 504v. AGRICULTURAL EDUCATION SEMINAR (1 per semester) *Professor Brunner and Staff*

AGR. ED. 506v, 506vX. PROBLEMS IN COUNTY VOCATIONAL SUPERVISION (1-3) Needs of county supervisors and vocational directors; co-operation with county superintendents, supervisory duties, plans of work, community meetings and organizations. *Professor Hall*

AGR. ED. 508v. STATE AND COUNTY ADMINISTRATION AND SUPERVISION OF AGRICULTURAL EDUCATION (1-3) Organization and administration of state, county, township, and district systems of agricultural education; state and federal legislation. *Professor Brunner*

AGR. ED. 509v, 509vX. TEACHER TRAINING IN AGRICULTURAL EDUCATION (1-6) Construction of college curricula, courses of study, and organization of college departments for the training of agricultural teachers.

AGR. ED. 520v, 520vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Methods of procedure in investigation and experimentation in education, accompanied by a critical examination of studies made in agricultural education. *Professor Brunner*

AGR. ED. 521v, 521vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Continuation of Agr. Ed. 520v; emphasis upon statistical techniques for students' individual problems. *Professor Hall*

AGR. ED. 522v, 522vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) Organization and administration of agricultural education in its local bearings; field laboratory surveys of local school conditions. *Professor Brunner and Staff*

AGR. ED. 523v, 523vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) *Professor Brunner and Staff*

AGR. ED. 524v, 524vX. ANNUAL PLAN OF WORK (1-3) A detailed study of the agricultural education needs of each student's community and the outlining of annual plans of work. *Professor Brunner*

AGR. ED. 525v. MASTER'S THESIS (1-6) Conferences and assignments in preparation of a thesis for the degree of Master of Science in agricultural education. *Professor Brunner and Staff*

AGR. ED. 530v. AGRICULTURAL COLLEGE TEACHING (3) Selection and organization of subject matter for specific courses, methods of learning, teaching devices, the technique of teaching, and the measurements of the results of teaching. *Professor Brunner and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGR. ED. 416v. RURAL EDUCATION (3) *Professor Hall*
AGR. ED. 417v, 417vX. RURAL EDUCATION SURVEY (2) *Professor Brunner*
AGR. ED. 418v, 418vX. SURVEY OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Professor Brunner*
AGR. ED. 420v, 420vX. ADVANCED VISUAL AND OTHER SENSORY AIDS IN TEACHING AGRICULTURE (1-6) *Professor McClay*
AGR. ED. 422v, 422vX. SUPERVISION OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Professor McClay*
AGR. ED. 434v, 434vX. AGRICULTURAL DEVELOPMENTS (1-6) *Professor Stevens*

AGRICULTURAL ENGINEERING

PROFESSOR RALPH U. BLASINGAME, B.S.
Head of the Department

AGR. ENG. 500. ADVANCED ELECTRO-AGRICULTURE (1-6) Investigations in the application of electrical energy to processing, storing, and handling agricultural products. Seminar, written reports.

Agr. Eng. 501. Advanced Farm Machinery (1-6) Application of agricultural engineering principles to design and operation of farm machinery. Prerequisite: Agr. Eng. 10.

Agr. Eng. 508. Advanced Problems in Farm Mechanics (1-15) Problems in farm shop practice and agricultural engineering related to the farm mechanics program of vocational education in agriculture. Prerequisites: Agr. Eng. 8, 14; or teaching experience in farm mechanics.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Agr. Eng. 400. Agricultural Engineering Problems and Seminar (1-7)
Agr. Eng. 401a,b,c,dS. Farm Mechanics for Teachers of Vocational Agriculture (1½-6)
Agr. Eng. 402. Functional Design of Farm Structures (3)
Agr. Eng. 405. Advanced Farm Electrification (3)
Agr. Eng. 406. Advanced Dairy Engineering (3)

AGRONOMY

Professor Herbert R. Albrecht, M.S., Ph.D.
Head of the Department

Agro. 501. Advanced Soil Fertility (4) Interpretation of fertility experiments and diagnosis of soil-plant relationships through field appraisal, analysis, and plant symptoms. Prerequisites: Agro. 431, Bot. 406. *Professor Merkle*

Agro. 503. Agronomy Seminar (1) A weekly meeting where papers and discussions will be presented by students and staff members. Each student will present a paper on some phase of his major subject.

Agro. 506. Soil Chemistry (4) Analyses of the important chemical and biochemical reactions occurring in soils, the conditions which control these reactions and their importance in soil genesis and plant growth; laboratory work in the more typical and significant analytical procedures; lectures, review of current literature, and practicum. Prerequisites: Agro. 419; Agr. Biochem. 417 or Chem. 20.
Professor Satchell

Agro. 507. Soil Physics (4) Physical properties of the soil; factors affecting them; their measurements, evaluation, and influence in the determination of soil productivity. Prerequisites: Agro. 419, Phys. 215, Agr. Biochem. 425.
Professor Alderfer

Agro. 509. Genetics of Crop Plants (3) The inheritance in crop plants with particular reference to factor interaction, the genetic aspects of linkage and crossing-over, quantitative inheritance, and heterosis. Prerequisite: Bot. 422.
Professor Carnahan

AGRO. 510. THE APPLICATION OF CYTOGENETICS TO PLANT BREEDING (3) Cytogenetics, including chromosome structure and behavior, chromosome alterations, polyploidy, interspecific hybridization and their applications to plant breeding. Prerequisite: Bot. 505. *Professor Carnahan*

AGRO. 511. THE BREEDING OF FARM CROPS (3) The application of genetic principles to the improvement of crop plants. Prerequisite: Hort. 7.

AGRO. 512. FIELD PLOT TECHNIQUE (3) Methods of conducting field experiments to obtain maximum efficiency and error control; sampling and statistical analysis of data covered. Prerequisite: Agro. 444 or Agr. Ec. 505. *Professor Fortmann*

AGRO. 516. HUMUS (2) The origin and chemical nature of soil organic matter, its importance in soil processes, and its decomposition. Prerequisites: Agro. 419, 431. *Professor Richer*

AGRO. 517. FARM CROPS ECOLOGY (2) The ecological factors influencing the distribution and production of field crops. Prerequisites: Math. 8, Bot. 406. *Professor Huber*

AGRO. 518. GROWTH AND MANAGEMENT OF FORAGE CROPS (3) Factors affecting growth and development of forage crops with particular reference to the effects of environment, defoliation, and management practices. Prerequisites: Agro. 423, Bot. 406. *Professor Sprague*

AGRO. 520. SPECIAL SOILS PROBLEMS (1-6 per semester) Provides basic or practical training in the soils sciences by means of library, field, and laboratory assignments.

AGRO. 545. THE APPLICATION OF STATISTICS TO FIELD EXPERIMENTS (4) Use of advanced experimental designs in planning, analyzing, and interpreting experiments; includes lattice designs, factorials, confounding, simple and multiple covariance techniques. Prerequisite: Agro. 512. *Professor Fortmann*

AGRO. 550. SPECIAL CROPS PROBLEMS (1-6 per semester) Provides basic or practical training in the crops sciences by means of library, field, and laboratory assignments.

AGRO. 582. SEMINAR IN BREEDING AND GENETICS OF FARM CROPS (1-8 per semester)

AGRO. 583S. LABORATORY METHODS IN FIELD CROPS (3) Prerequisite: Agro. 512. *Professor Carnahan*

AGRO. 591. THESIS RESEARCH (1-15 per semester) Thesis research in the various crops and soils sciences falling within the research program of the department.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

AGRO. 402. THE NATURE OF SOIL MINERALS (3) *Professor Jeffries*
AGRO. 416. THE CLASSIFICATION AND MAPPING OF SOILS (4) *Professor Higbee*
AGRO. 419. SOIL PROPERTIES (5) *Professor Merkle*

AGRO. 422. SOIL CONSERVATION (3) *Professor Alderfer*
AGRO. 423. PASTURE AND GRASSLAND MANAGEMENT (3) *Professor Washko*
AGRO. 431. SOIL FERTILITY AND MANAGEMENT (3) *Professor Merkle*
AGRO. 444. METHODS OF STATISTICAL ANALYSIS OF BIOLOGICAL DATA (4) *Professor Fortmann*
AGRO. 490. AGRONOMIC PRACTICES (1-6)

ANIMAL HUSBANDRY

PROFESSOR FRANKLIN L. BENTLEY, M.S.
Head of the Department

A.H. 501. PEDIGREE STUDY (1-6) Research work in breed study history, and analytical study of breed pedigrees, and a complete survey of the herd, flock, or stud book. *Professor Henning*

A.H. 502. RESEARCH IN MEATS (1-6 per semester) Investigation of methods for handling, cutting, processing, freezing, and curing meat and meat products. Prerequisite: A.H. 421. *Professor Ziegler*

A.H. 503. LIVESTOCK MANAGEMENT (3) The handling of purebred herds and flocks; the relation of the livestock breeders to the public and methods of developing purebred herds and flocks through careful breeding. *Professor Bentley and Staff*

A.H. 504. LIVESTOCK HEALTH PROBLEMS (3) Problems dealing with the regulations governing the movement of livestock with special reference to control measures applicable to diseases and disease groups common to men and animals. Prerequisites: A.H. 5, 415. *Professor Bortree*

A.H. 505. ADVANCED ANIMAL BREEDING (1-5) Special problems in animal genetics as applied to breeding and improvement of horses, cattle, sheep, and swine. Prerequisites: A.H. 22, Bot. 22. *Professor Henning*

A.H. 506. RESEARCH IN ANIMAL HUSBANDRY (2-10 per semester) The prosecution of an assigned problem under the guidance of an instructor. Prerequisites: A.H. 415, 421; or 426.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

A.H. 415. ADVANCED ANATOMY AND PHYSIOLOGY (3) *Professor Bortree*
A.H. 421. ADVANCED MEAT STUDIES (3) *Professor Ziegler*
A.H. 423. ADVANCED STOCK JUDGING (2) *Professor Henning*
A.H. 424. ANIMAL HUSBANDRY SURVEY (1) *Professor Bentley and Staff*
A.H. 426. LIVESTOCK MARKETS AND MARKETING (3) *Professor Bentley*
A.H. 428. ADVANCED ANIMAL NUTRITION (3) *Professor Bentley and Staff*
A.H. 431. ADVANCED MEAT JUDGING (1)

ANIMAL NUTRITION

Professor Raymond W. Swift, M.S., Ph.D.
Head of the Department

An. Nutr. 500. Research in Animal Nutrition (Credit to be arranged) Participation in the research program of the Department of Animal Nutrition and independent investigation. The available facilities make it possible to accommodate only a small number of students.

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

An. Nutr. 401. Physiology of Nutrition (3) *Professor Black*
An. Nutr. 402. Physiology of Nutrition (3) *Professor French*

ARCHITECTURAL ENGINEERING

Consult Professor Louis A. Richardson, M.S.

A.E. 502. Architectural Engineering (3-8) Advanced structural design in steel and reinforced concrete. Lectures and class criticism. Practicum and seminar. *Professor Richardson and Staff*

A.E. 503. Architectural Engineering (4-8) Continuation of A.E. 502 in which problems of wind bracing in tall buildings, rigid frames, and heavy-framed constructions are studied. Practicum and seminar. *Professor Fox*

A.E. 504. Architectural Engineering (4-8) Statically indeterminate stresses in steel and reinforced concrete buildings; area moment, slope deflection, and moment distribution methods. Recitation and seminar. *Professor Richardson and Staff*

A.E. 506. Architectural Engineering Research (1-15) The presentation of an assigned problem under the guidance of an instructor. *Professors Richardson and Fox*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

A.E. 401. Architectural Engineering (3)
A.E. 402. Architectural Engineering (4)
A.E. 403. Architectural Engineering (3)
A.E. 420. Architectural Engineering (3)
A.E. 421. Architectural Engineering (4)
A.E. 422. Architectural Engineering (3)
A.E. 423. Architectural Engineering Thesis (2)
A.E. 424. Architectural Engineering Thesis (5)

ARCHITECTURE

PROFESSOR MILTON S. OSBORNE, M.S.
Head of the Department

ARCH. 501. ARCHITECTURAL DESIGN (4-8) Problems in advanced planning and design, including study of group composition. Practicum and seminar.
Professor Osborne and Staff

ARCH. 502. ARCHITECTURAL RESEARCH (2-12) The prosecution of assigned problems under the guidance of an instructor. *Professor Osborne and Staff*

ARCH. 503. ARCHITECTURAL HISTORY RESEARCH (3-12) Original research in architectural history. Seminar and written reports. *Professor Dickson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ARCH. 410. ADVANCED ARCHITECTURAL DESIGN (2-12) *Professor Osborne and Staff*
ARCH. 411. ADVANCED ARCHITECTURAL DESIGN (8)
ARCH. 412. ADVANCED ARCHITECTURAL DESIGN AND THESIS (8)
ARCH. 421. CONTEMPORARY ARCHITECTURE (3) *Professor Norton*

ART

PROFESSOR MILTON S. OSBORNE, M.S.
Head of the Department of Architecture

(See also courses in Art Education below.)

ART 500. ART RESEARCH (2-6) The prosecution of assigned problems under the guidance of an instructor. *Professor Galbraith*

ART 501. ITALIAN PAINTING (2-6) Investigations of early Italian painting. Seminar, written reports. *Professor Dickson*

ART 502. MEDIEVAL SCULPTURE (2-6) Sculpture of Italy and France from the 9th to the 13th centuries. Seminar, written reports. *Professor Dickson*

ART 503. ART HISTORY RESEARCH (3-12) Original investigation in art history, to be pursued independently or concurrently with course work in particular fields. Prerequisite: 6 credits in history of art. *Professor Dickson and Staff*

ART 504. SEMINAR: ART LITERATURE AND ICONOGRAPHY (2-6) Methods of research in the fine arts; survey of the literature of art; studies in iconography. Prerequisite: 6 credits in history of art. *Professor Dickson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ART 400. OIL PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9)
ART 403S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Professor Dickson*
ART 404S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Professor Dickson*
ART 410. WATER-COLOR PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9) *Professor Case*
ART 442S. ART OF THE MIDDLE AGES AND RENAISSANCE IN ITALY (3)
ART 443S. ART IN AMERICA (3)
ART 444S. ART IN NORTHERN EUROPE (3)
ART 490. LIFE DRAWING (3) *Professor Case*

ART EDUCATION

Consult PROFESSOR VIKTOR LOWENFELD

ART ED. 514. FUNCTIONAL RELATIONSHIPS IN CRAFTS (3) Relationships of material design and purpose in crafts discussed by means of outstanding products of different materials, periods, and cultures. Prerequisite: 6 credits in crafts or 3 in design and 3 in advanced crafts. *Professor Emerson*

ART ED. 534. CREATIVE ART ACTIVITY FOR THE HANDICAPPED (3) Specific methods for development of creative art activity with the physically, mentally, emotionally, and socially handicapped; adjustive effect upon them. Prerequisite: 6 credits in art education or 6 in special education or 6 in psychology. *Professor Lowenfeld*

ART ED. 586. RESEARCH IN ART EDUCATION (3-9) Current experiments in art education; required of students working for a master's degree in art education. *Professor Lowenfeld*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ART ED. 402. METHODS OF TEACHING DRAWING IN THE GRADES (2-3) *Professor Emerson*
ART ED. 404. METHODS OF GRAPHICS AND ILLUSTRATIONS (3)
ART ED. 414. ADVANCED CRAFTS FOR TEACHERS (3-6) *Professor Emerson*
ART ED. 434. ART APPRECIATION IN THE EDUCATIONAL PROGRAM (2-3)
ART ED. 434b, 434bX. ART IN THE ELEMENTARY SCHOOL (2-3) *Professor Lowenfeld*
ART ED. 434c, 434cX. ART IN THE SECONDARY SCHOOL (2-3) *Professor Lowenfeld*
ART ED. 434d. ART SUPERVISION (3) *Professor Lowenfeld*
ART ED. 486, 486X. CURRENT PROBLEMS IN ART EDUCATION (2-3) *Professor Lowenfeld*
ART ED. 487. MURAL PAINTING IN SCHOOLS (3) *Professor Lowenfeld*
ART ED. 488. ADVANCED MURAL PAINTING IN SCHOOLS (3) *Professor Lowenfeld*

BACTERIOLOGY

PROFESSOR ROBERT W. STONE, Ph.D.
Head of the Department

BACT. 504. DAIRY BACTERIOLOGY PROBLEMS (2-15) Research on the microorganisms of importance in dairy sanitation, milk production, and manufacture of dairy products. Prerequisite: 12 credits in bacteriology.

BACT. 505. PATHOGENIC BACTERIOLOGICAL PROBLEMS (2-15) Problems on the morphological, cultural, and immunological characteristics of pathogenic bacteria. Prerequisite: 12 credits in bacteriology.

BACT. 506. RESEARCH (2-15) Research in bacteriology for students who are doing their major work in this subject for the master's or doctor's degree. Prerequisite: 12 credits in bacteriology.

BACT. 507. BACTERIOLOGICAL SEMINAR (1-6) Reports on current fields of research. Prerequisite: 12 credits in bacteriology.

BACT. 508. PHYSIOLOGY OF BACTERIA (2) Metabolic processes of bacteria as influenced by their environment; the mechanism of fermentation and respiration of microorganisms. Prerequisite: Bact. 412.

BACT. 508a. LABORATORY IN PHYSIOLOGY OF BACTERIA (2) Laboratory work to accompany the lectures given in Bact. 508. Prerequisite: Bact. 412.

BACT. 509. FERMENTATION (2) The chemical action of microorganisms on their environment; theories of carbohydrate breakdown and the application of these theories to industrial and agricultural fermentations. Prerequisites: Bact. 1, Chem. 31.

BACT. 510. METHODS AND ANALYSES IN BACTERIAL FERMENTATION (2) Laboratory procedures and problems in fermentation to accompany Bact. 509. Prerequisites: Bact. 1, Chem. 31.

BACT. 511. BACTERIOLOGICAL LITERATURE (2-4) Assigned reading and conferences dealing with a student's research problem. May be taken only in those instances where a student is not scheduling Bact. 504, 505, or 506. Discussion and written reports. Prerequisite: 12 credits in bacteriology.

BACT. 512. LABORATORY IN ADVANCED BACTERIOLOGICAL TECHNIQUES (2-6) Certain techniques used in research including work with single cell isolation, Warburg apparatus, tissue culture and serology. May be repeated with credit. Prerequisite: 12 credits in bacteriology.

BACT. 515. PATHOGENIC BACTERIOLOGY AND VIROLOGY (3-6) Important bacterial, rickettsial, and viral agents parasitizing man and animals; immunological and epidemiological considerations of host response. Prerequisite: Bact. 410.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

BACT. 401. GENERAL MICROBIOLOGY (4)
BACT. 407. BACTERIOLOGY PROBLEMS (2-9)
BACT. 410. IMMUNOLOGY AND SEROLOGY (4)
BACT. 411. BACTERIOLOGICAL SURVEY (1)
BACT. 412. ADVANCED BACTERIOLOGY (4)
BACT. 413. SOIL MICROBIOLOGY (3)
BACT. 414. FOOD MICROBIOLOGY (4)
BACT. 416. INDUSTRIAL MICROBIOLOGY (4)

BOTANY

PROFESSOR HENRY W. POPP, M.S., Ph.D.
Head of the Department

BOT. 500. PLANT PHYSIOLOGY SEMINAR (1 per semester) Selected topics from recent literature; staff and student reports on current research.
Professors Popp and Van Norman

BOT. 501. THE PHYSIOLOGY OF THE FUNGI (3) Chemical composition, metabolism, toxic and stimulating agencies, spore germination, growth and irritability of the fungi. Prerequisites: Bot. 406, 419, and preferably Chem. 32.
Professor Fergus

BOT. 505. CYTOLOGY AND CYTOGENETICS (3) Cells and their components; nuclear and cell division, meiosis and fertilization; the chromosome mechanism of heredity. Prerequisites: Bot. 22, 421. *Professor Wright*

BOT. 506. COMPARATIVE ANATOMY OF VASCULAR PLANTS (3) Structure of the Tracheophyta from a phylogenetic standpoint. Prerequisite: Bot. 407.
Professor Kribs

BOT. 508. PROBLEMS IN GENETICS (2-6) Problems to suit needs of individual students; conferences and laboratory work. Prerequisite: Bot. 422.
Professor Wright

BOT. 509. PHYSIOLOGY OF PATHOGENICITY (3) Physiological processes of plant pathogenic bacteria and fungi occurring during incubation, ingress, and infection. Prerequisite: Bot. 10, 11, or 419. *Professor Paddock*

BOT. 511. PHYSIOLOGY OF PLANT GROWTH AND DEVELOPMENT (2-4) Prerequisite: Bot. 406. *Professor Popp*

BOT. 512. PHYSIOLOGY OF PLANT METABOLISM (2-4) Prerequisite: Bot. 406.
Professor Van Norman

BOT. 513. WATER AND MINERAL RELATIONS OF PLANTS (2-4) Absorption of water and minerals; transport of materials within the plant; physiology of transpiration. Prerequisite: Bot. 406. *Professor Van Norman*

BOT. 515. DISEASE RESISTANCE IN PLANTS (2-4) Stability of resistance, selection of resistant material, economics of control, special problems. Prerequisites: Bot. 22 or 32, 10. *Professors Wernham and Mills*

BOT. 518. BOTANICAL PROBLEMS (1-15 per semester) *Professor Popp and Staff*

BOT. 519. PLANT VIRUSES (3) Nature, symptomatology, transmission, and control of virus diseases of plants. *Professor Boyle*

BOT. 520. PLANT PATHOGENIC BACTERIA (3) Bacteria causing plant diseases, methods of identification, inoculation and control. *Professor Kneebone*

BOT. 521. MOLDS, YEASTS, AND ACTINOMYCETES (3) Morphology and taxonomy of fungi important in microbiology; identification and techniques of study. *Professor Sinden*

BOT. 522. MYXOMYCETES, PHYCOMYCETES, AND ASCOMYCETES (4) Morphology, taxonomy, phylogeny, and life histories; identification and field work. Prerequisite: Bot. 419. *Professor Fergus*

BOT. 523. BASIDIOMYCETES AND FUNGI IMPERFECTI (4) Morphology, taxonomy, phylogeny, and life histories. Prerequisite: Bot. 419. *Professor Fergus*

BOT. 524. SEMINAR IN GENETICS (1 per semester) Review of current research publications in genetics. *Professor Wright*

BOT. 527aS, 527bS. PLANT BIOLOGY (3 per course) (a) Structure and physiology; (b) reproduction processes, development and relationships of plant groups. Methods of obtaining materials and setting up experiments. Given in alternate years. Prerequisite: general biology or general botany courses.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

BOT. 406.	PLANT PHYSIOLOGY (4)	*Professor Van Norman*
BOT. 407.	PLANT ANATOMY (3)	*Professor Kribs*
BOT. 408.	PLANT PATHOLOGICAL TECHNIQUES (3)	*Professor Paddock*
BOT. 409.	PLANT ECOLOGY (3)	*Professor Kovar*
BOT. 412.	ADVANCED FOREST PATHOLOGY (3)	*Professor Fergus*
BOT. 414.	TAXONOMY OF VASCULAR PLANTS (3)	*Professor Wahl*
BOT. 415.	MORPHOLOGY OF THE ALGAE (3)	*Professor Wahl*
BOT. 416.	MORPHOLOGY OF THE BRYOPHYTES (2)	*Professor Grove*
BOT. 417.	MORPHOLOGY OF THE TRACHEOPHYTA EXCLUSIVE OF ANGIOSPERMS (3)	*Professor Grove*
BOT. 418.	BOTANICAL PROBLEMS (1-6)	*Professor Popp and Staff*
BOT. 419.	MYCOLOGY (3)	*Professor Fergus*
BOT. 420.	MORPHOLOGY OF THE ANGIOSPERMS (3)	*Professor Grove*
BOT. 421.	BOTANICAL TECHNIQUE (3)	*Professor Grove*
BOT. 422.	ADVANCED GENETICS (3)	*Professor Wright*
BOT. 424.	COMMERCIAL TROPICAL WOODS (3)	*Professor Kribs*
BOT. 425a, 425b.	STRUCTURE OF ECONOMIC PLANTS (3-6)	*Professor Grove*

Bot. 426. Photomicrography (2) *Professor Kribs*
Bot. 427. Advanced Systematic Botany (1-6) *Professor Wahl*
Bot. 428. Advanced Plant Pathology (2) *Professor Paddock*
Bot. 432S. Genetics, Eugenics, and Evolution (3) *Professor Wright*

CERAMICS

Professor Edward C. Henry, M.S., Cer.E., Ph.D.
Chief of the Division

Cer. 500. Ceramics Seminar (1 per semester) Conferences, reading, and reports. Required of all graduate students in ceramics. Prerequisites: Chem. 41, Phys. 285. *Professor Henry and Staff*

Cer. 501. Ceramics Research (1-15 per semester) Laboratory study on special ceramic problems. *Professor Henry and Staff*

Cer. 502. Heat Treatment of Ceramic Materials (2-5) Effect of controlled heat treatment on physical and chemical properties of various mineral systems.

Cer. 503. Constitution of Glass (2-4) An advanced course on glass dealing with the latest developments in the structure of viscous liquids and transparent amorphous solids. Prerequisite: Cer. 415. *Professor Weyl*

Cer. 504. Research Instruments and Equipment (2) Applications of fundamental laws and principles in research instruments; care, adjustment, and effective use of instruments and equipment (demonstrations). Prerequisite: Cer. 411.

Cer. 505. Glass Technology Research (1-15 per semester) Laboratory studies on special problems concerning the properties, constitution, and manufacture of glass. Prerequisite: Cer. 415. *Professor Weyl and Staff*

Cer. 506. Glass Technology Seminar (1-6) Group discussion of special advanced topics concerning the properties and manufacture of glass. Prerequisite: Cer. 415.

Cer. 507. Coloring and Decolorizing Glass (1) Physical-chemical considerations of the various coloring oxides; oxidation-reduction equilibria pertaining to coloring and decolorizing of glass. Prerequisite: Cer. 415. *Professor Weyl*

Cer. 508. Colloidal Behavior of Industrial Clays, Muds, and Slimes (2-3) Colloidal activity in bodies, glazes, and enamels, drilling fluids, filtering and bleaching clays, and similar mineral systems. (In co-operation with the Petroleum and Natural Gas staff.) Prerequisite: Chem. 41. *Professor Henry*

Cer. 509. Silicate Systems (3) The properties of silica; classification of silicates; reactions in binary and ternary systems; industrial applications of the phase rule. Prerequisites: Chem. 41, Cer. 303. *Professor Matson*

CER. 510. CERAMIC PROBLEMS (1-6 per semester) Advanced individual study on a problem in some branch of ceramics, including review of the literature and a full report. Prerequisite: Cer. 411. *Professor Henry and Staff*

CER. 511. SELECTED TOPICS IN CERAMICS (1-3 per semester) Intensive group study of special subjects, such as diffusion in solids, viscosity, and kinetics of ceramic processes. Prerequisites: Chem. 41, Phys. 285. *Professor Henry and Staff*

CER. 512. SYNTHESIS OF CERAMIC COMPOUNDS (3) Advanced ceramic technology applied to the control of phases formed in commercial production of glass, whitewares, refractories, and cements. Prerequisites: Chem. 41, Cer. 303. *Professor Hummel*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CER. 400. SPECIAL TOPICS (1-2)
CER. 401. CERAMIC BODIES AND GLAZES (3) *Professor Hummel*
CER. 402. PRINCIPLES OF CERAMIC ENGINEERING (3) *Professor Henry*
CER. 403. CERAMIC ENGINEERING PROCESSES AND EQUIPMENT (3) *Professor Ehman*
CER. 404. CERAMICS SEMINAR (1) *Professor Henry and Staff*
CER. 405. CERAMIC RESEARCH AND DESIGN (3) *Professor Henry and Staff*
CER. 411. THEORY OF CERAMIC PROCESSES (2) *Professor Hummel*
CER. 413, 413X. CERAMIC PETROGRAPHY (3) *Professor Matson*
CER. 415. GLASS AND ENAMELS (3) *Professor Ehman*
CER. 416. ADVANCED GLASS TECHNOLOGY (3) *Professors Weyl and Rindone*
CER. 420. REFRACTORIES (3) *Professor Matson*

CHEMICAL ENGINEERING

PROFESSOR DONALD S. CRYDER, M.S., D.Sc.
Head of the Department

CHEM. ENG. 500. SEMINAR IN CHEMICAL ENGINEERING (1) Required of all graduate students.

CHEM. ENG. 510. ADVANCED HEAT TRANSFER I (3) The physical and chemical factors controlling the rate of heat transfer under conditions of steady flow. *Professor Cryder*

CHEM. ENG. 511. ADVANCED HEAT TRANSFER II (3) Flow of heat under varying temperature conditions. *Professor Cryder*

CHEM. ENG. 515. DISTILLATION (3) Commercial distillation, equilibrium diagrams, vapor composition, stills and rectifying and stripping columns. *Professor Carnahan*

CHEM. ENG. 516. ECONOMIC BALANCE (3) Problem work on the design of chemical engineering equipment from the economic standpoint. *Professor Cannon*

CHEM. ENG. 518. CHEMICAL ENGINEERING DESIGN (3) Complicated examples are discussed and worked out. Several different unit operations will be combined for the design of a complete installation. *Professor Cryder*

CHEM. ENG. 524. CHEMICAL ENGINEERING, APPLICATION OF THERMODYNAMICS (3) Elements of thermochemistry and thermodynamics of greatest importance in chemical engineering. *Professor Cannon*

CHEM. ENG. 580. RESEARCH IN PETROLEUM REFINING (3-15) Charge will be made for supplies consumed and breakage of equipment.
Professors Fenske and Quiggle

CHEM. ENG. 599. RESEARCH IN CHEMICAL ENGINEERING (1-15) Charge will be made for supplies consumed and breakage of equipment.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CHEM. ENG. 402. CHEMICAL ENGINEERING (4) *Professor Carnahan*
CHEM. ENG. 403. CHEMICAL ENGINEERING (4) *Professor Carnahan*
CHEM. ENG. 422. MOTOR FUELS (2) *Professor Carnahan*

CHEMISTRY

PROFESSOR W. CONARD FERNELIUS, M.A., Ph.D.
Head of the Department

CHEM. 500. SEMINAR IN INORGANIC, MICRO, AND HOUSEHOLD CHEMISTRY (1)

CHEM. 501. SEMINAR IN PHYSICAL CHEMISTRY (1)

CHEM. 502. SEMINAR IN ORGANIC CHEMISTRY (1)

CHEM. 503. SEMINAR IN ANALYTICAL CHEMISTRY (1)

CHEM. 515. INORGANIC CHEMISTRY (2) Adapted to the needs of those desiring a general treatment of inorganic chemistry at an advanced level. *Professor Holtzinger*

CHEM. 516. SYSTEMATIC INORGANIC CHEMISTRY (3) A systematic treatment of inorganic chemistry in terms of modern concepts.
Professors Fernelius, Douglas, and Wartik

CHEM. 517. CHEMISTRY OF THE LESS FAMILIAR ELEMENTS (3) Continuation of Chem. 516. *Professors Fernelius, Douglas, and Wartik*

CHEM. 518. SPECIAL TOPICS IN INORGANIC CHEMISTRY (3 per semester) Modern developments in specialized fields.

CHEM. 525. ANALYTICAL CHEMISTRY (3) Analytical principles as applied to the analysis of inorganic and organic substances. *Professor Elving*

CHEM. 526. ADVANCED ANALYTICAL CHEMISTRY (3) Theory and practice of contemporary analytical chemistry as used in chemical research and plant operation. *Professor Elving*

CHEM. 527. SPECIAL TOPICS IN ANALYTICAL CHEMISTRY (2-12) Currently used techniques in analytical chemistry.

CHEM. 531. SPECIAL TOPICS IN ORGANIC CHEMISTRY (3) May be taken for credit for four successive semesters.

CHEM. 532. ORGANIC NITROGEN COMPOUNDS (3) Chemistry, stereochemistry, and molecular structure of organic compounds containing nitrogen. *Professor Aston*

CHEM. 534. THEORETICAL ORGANIC CHEMISTRY (3) Modern theories of structure; resonance; interpretation of physical properties; theory of rates; equilibrium properties. *Professor Aston*

CHEM. 535. ORGANIC CHEMISTRY (3) Adapted to the needs of those doing research work in organic chemistry. *Professor Zook*

CHEM. 536. ORGANIC CHEMISTRY (3) Continuation of Chem. 535. *Professor Zook*

CHEM. 538. ORGANIC CHEMISTRY (3) Survey of organic chemistry arranged primarily for graduate students majoring in fields other than organic chemistry. *Professors Noll and Oakwood*

CHEM. 539. STEREOCHEMISTRY (3) A comprehensive treatment of the principles of stereochemistry as applied to organic compounds. *Professor Oakwood*

CHEM. 541. PHASE RULE (3) The phase rule and its applications. Given 1952-53 and in alternate years thereafter. *Professor Currier*

CHEM. 542. COLLOIDS (3) The physics and chemistry of surfaces and their resulting colloid properties. Methods of preparating colloids. *Professor Smith*

CHEM. 543. RHEOLOGY OF COLLOIDS (3) Continuation of Chem. 542. Rheology, especially as applied to colloids and similar substances. *Professor Smith*

CHEM. 544. CHEMICAL THERMODYNAMICS (3) Development of thermodynamic theory with special reference to common physical changes and chemical reactions. Prerequisite: Chem. 441 or 562. *Professor Aston*

CHEM. 545. CHEMICAL THERMODYNAMICS AND INTRODUCTORY STATISTICAL MECHANICS (3) Continuation of Chem. 544 including the calculation of thermodynamic properties from molecular and spectroscopic data. Prerequisite: Chem. 544. *Professor Aston*

CHEM. 546. QUANTUM CHEMISTRY (3) Theory of energy levels in atoms and molecules from the standpoint of wave mechanics with special emphasis on the

portion of the subject applying to common chemical systems. Prerequisite: Chem. 441 or 562. Given alternate years only. *Professor Aston*

CHEM. 547. STATISTICAL MECHANICS (3) Properties of matter at equilibrium, developed on the basis of energy levels of molecules and statistical mechanical theory. Prerequisite: Chem. 546. Given alternate years only. *Professor Aston*

CHEM. 548. CATALYSIS (3) The theory of catalysis and its application to industry. Given 1951-52 and in alternate years thereafter. *Professor Currier*

CHEM. 550. RESEARCH IN HOUSEHOLD CHEMISTRY (1-15) Charge will be made for supplies consumed and breakage of equipment. *Professor Mack*

CHEM. 561. CHEMICAL PRINCIPLES (3) A mathematical treatment of the classical principles of chemistry; their application to problems. Required of all graduate students. Prerequisites: Chem. 41, Math. 11, Phys. 285. A course in organic chemistry is recommended. *Professor Aston*

CHEM. 562. CHEMICAL PRINCIPLES (3) Continuation of Chem. 561. Required of all graduate students. *Professor Aston*

CHEM. 563. CHEMICAL KINETICS (3) The theory and measurement of the rates of chemical reactions; the mechanism of chemical reactions. *Professors Ascah and Taft*

CHEM. 564. CHEMICAL KINETICS (3) Continuation of Chem. 563 but including the theory and measurement of photochemical reactions. *Professors Ascah and Taft*

CHEM. 565. ATOMIC AND MOLECULAR STRUCTURE (3) The structure of chemical species and the correlation of experimentally determined properties by structural theory.

CHEM. 566. ATOMIC AND MOLECULAR STRUCTURE (3) Continuation of Chem. 565.

CHEM. 567. ADVANCED THEORETICAL CHEMISTRY (3) Modern and current theories of the properties of chemical substances and their applications to chemical problems; the construction of chemical theory.

CHEM. 568. ADVANCED THEORETICAL CHEMISTRY (3) Continuation of Chem. 567.

CHEM. 580. RESEARCH IN PETROLEUM REFINING (1-15) Charge will be made for supplies consumed and breakage of equipment. *Professor Fenske*

CHEM. 599. RESEARCH IN CHEMISTRY (1-15) Charge will be made for supplies consumed and breakage of equipment.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CHEM. 400. CHEMICAL LITERATURE (1) *Miss Jackson*
CHEM. 411. FLUORINE CHEMISTRY (3)

CHEM. 412. FLUORINE CHEMISTRY (3)

CHEM. 413. INORGANIC PREPARATIONS AND LABORATORY METHODS (2-5) *Professor Douglas*

CHEM. 426. ADVANCED QUALITATIVE AND QUANTITATIVE ANALYSIS (3-5) Breakage ticket $10. *Professor Hayes*

CHEM. 434. QUANTITATIVE ORGANIC ANALYSIS (3-5) Breakage ticket $10 for 3 credits, $12 for 4 or 5 credits.

CHEM. 435. ORGANIC PREPARATIONS AND LABORATORY METHODS (3-5) Breakage ticket $10 for 3 credits, $12 for 4 or 5 credits. *Professor Oakwood*

CHEM. 436. ORGANIC CHEMISTRY OF NATURAL PRODUCTS (3) *Professor Aston*

CHEM. 437. QUALITATIVE ORGANIC ANALYSIS (3) Breakage ticket $4. *Professors Olewine and Noll*

CHEM. 440. ADVANCED PHYSICAL CHEMISTRY (3) *Professors Hutchison and Seward*

CHEM. 441. ADVANCED PHYSICAL CHEMISTRY (3) *Professors Hutchison and Seward*

CHEM. 448. COLLOID CHEMISTRY (3) Breakage ticket $3. *Professor Hutchison*

CHEM. 453a-h. RECENT ADVANCES IN TEXTILE CHEMISTRY (1-8)

CHEM. 470. CHEMICAL MICROSCOPY (3) Breakage ticket $2. *Professor Willard*

CHEM. 471. ADVANCED CHEMICAL MICROSCOPY (3) Breakage ticket $2. *Professor Willard*

CHEM. 472. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket $2. *Professor Fleming*

CHEM. 473. TEXTILE MICROSCOPY (3) Breakage ticket $2. *Professor Willard*

CHEM. 474. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket $2. *Professor Fleming*

CHEM. 475. INTRODUCTION TO CHEMICAL SPECTROSCOPY (3) Breakage ticket $2. *Professor Schempf*

CHEM. 476. MICROSCOPIC MICROTECHNIQUE (3) Breakage ticket $2. *Professor Willard*

CHEM. 477. PAPER MICROSCOPY (3) Breakage ticket $2 *Professor Willard*

CHEM. 489. INTRODUCTION TO CHEMICAL RESEARCH (3-5)

†CHEM. 490. ORGANIC CHEMISTRY (5) Breakage ticket $4. *Professor Olewine*

†CHEM. 491. ORGANIC CHEMISTRY (5) Breakage ticket $12. *Professor Olewine*

†CHEM. 492a. ADVANCED GENERAL CHEMISTRY (3) Breakage ticket $3. *Professor Currier*

†CHEM. 496. GENERAL PHYSICAL CHEMISTRY (3) *Professor Seward*

†CHEM. 497. GENERAL PHYSICAL CHEMISTRY (3) *Professor Seward*

†CHEM. 498. PHYSICOCHEMICAL MEASUREMENTS (1) Breakage ticket $6. *Professor Ascah*

†CHEM. 499. PHYSICOCHEMICAL MEASUREMENTS (1) Breakage ticket $6. *Professor Ascah*

† Candidates for the M.Ed. degree.

CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS

PROFESSOR WINONA L. MORGAN, M.A., Ph.D.
Head of the Department

CH. FAM. 500. RESEARCH IN CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (1-6 per semester)

CH. FAM. 501. THESIS (1-15)

CH. FAM. 508. PARENTAL EDUCATION (3) Discussion and use of methods, experiences, and programs which can be used effectively to help parents in dealing with problems of parent-child relationships. Prerequisites: Ch. Fam. 429, 430.
Professor Morgan

CH. FAM. 515, 515X. THE TEACHING OF CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (3) Methods of selection and presentation of subject matter basic to understanding the development of children, and the attitudes, emotions, and relationships within the family. Not open to students having credit for Ch. Fam. 482. Prerequisite: 6 credits in child development and family relationships.
Professor Morgan

CH. FAM. 536. CHILDREN IN POSTWAR FAMILIES AND COMMUNITIES (3) Postwar family and community situations influencing the development of children; the role of parents and teachers in helping individual children make satisfactory adjustments. Prerequisites: Ch. Fam. 429, 430, or 2 courses in psychology.
Professor Morgan

CH. FAM. 540. SEMINAR IN CHILD DEVELOPMENT (1-6) Readings and reports on recent findings in child development. Prerequisites: Ch. Fam. 429, 430, or Psy. 411, or 425. *Professor Morgan*

CH. FAM. 545, 545X. THE FAMILY IN ITS COMMUNITY (2-3) Cultural influences on family relationships; how the family orients its members to community living and group participation. Prerequisites: Soc. 1, Ch. Fam. 405; Rur. Soc. 452 or Psy. 419. *Professor Smith*

CH. FAM. 546. SEMINAR IN FAMILY RELATIONSHIPS (1-3) Reading, reports, and discussion of recent research in relationship aspects of family living; particular attention to studies of roles, crises, and adjustments within the family setting. Prerequisite: Ch. Fam. 405 or 6 hours of sociology or psychology. *Professor Smith*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

CH. FAM. 405. MARRIAGE AND FAMILY RELATIONSHIPS (3) *Professor McDowell*
CH. FAM. 429, 429X. CHILD DEVELOPMENT (3) *Professor Avery*
CH. FAM. 430. OBSERVATION AND EXPERIENCE IN NURSERY SCHOOL (1-5)

Ch. Fam. 440, 440X. Study of Later Childhood (3) *Professor Avery*
Ch. Fam. 441. Nursery School Organization (3)
Ch. Fam. 481. Educational Methods with Preschool Children (3)
Ch. Fam. 482. Educational Procedures in Child Development and Family Relations (3) *Professor Morgan*
Ch. Fam. 495S. Family Health and Human Relations (3-9)

CIVIL ENGINEERING

Professor Benjamin A. Whisler, M.S., Sc.D.
Head of the Department

C.E. 500. Seminar in Civil Engineering (1-6) Reports on researches and special topics. Course may be continued in subsequent semesters.

C.E. 521. Transport Planning and Design (2-6) Planning and design of transportation facilities; basic principles and engineering techniques applied to airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

C.E. 522. Transport Operation and Maintenance (2-6) Engineering problems in the operation, maintenance, and administration of airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

C.E. 540. Advanced Structural Analysis (2-4) Geometry of flexure; deflections; analysis of continuous beams, rigid frames, arches; influence lines. Prerequisite: C.E. 40.

C.E. 541. Advanced Structural Analysis (2-4) Truss deflection; trusses with redundant members, continuous trusses, framed arches; influence lines; secondary stresses; wind stresses; space framework; suspension bridges. Prerequisite: C.E. 40.

C.E. 542. Applied Soil Mechanics (2-5) Soil classification by type of clay minerals and profile development; aerial photographic interpretation of soils and applications to site selection for dams, highways, and airports. Prerequisites: C.E. 412, 444, Geol. 71.

C.E. 543. Structural Engineering Projects (3-10) Investigation or design projects in concrete, soil mechanics, photoelasticity, analysis, etc. Prerequisite or concurrent: C.E. 441, 442.

C.E. 544. Advanced Structural Design (2-4) Plain and reinforced concrete design as applied to buildings, bridges, retaining walls, domes, tanks, and dams; prestressed concrete. Prerequisites: C.E. 42, 442.

C.E. 545. Advanced Structural Design (2-4) Structural steel design as applied to riveted and welded girders, trusses, rigid frames, wind connections; timber design. Prerequisite: C.E. 41.

C.E. 550. Engineering Construction (2-4) Construction methods applied to foundations, buildings, bridges, and other civil engineering construction work. Prerequisites: C.E. 41, 42.

C.E. 551. Hydrologic Investigations (2-8) Application of hydrologic principles and techniques to a specific project. Prerequisite: C.E. 451.

C.E. 560. Hydraulic Structures (3) Hydraulic and structural considerations in the design of dams, spillways, gates, canals and flumes, siphons, and locks. Prerequisite: C.E. 462.

C.E. 562. Advanced Fluid Mechanics (3) Euler's equations, potential theory, flow nets, conformal mapping, boundary layers, turbulence, compressibility, wave theory, flow of viscous fluids.

C.E. 563. Hydraulics Research (2-8) Analytical or experimental study of a problem in hydraulics. Prerequisite: C.E. 462.

C.E. 566. Fluid Mechanics of Hydraulic Machinery (3) Advanced theory and design of hydraulic machinery. Prerequisite: C.E. 466.

C.E. 568. Theoretical Hydrodynamics (3) Analysis of the irrotational motion of fluids in two and three dimensions, vortex motion, wave theory, theory of viscous fluids. Prerequisite: C.E. 562.

C.E. 569. Research in Fluid Dynamics (1-8) Analytical or experimental study of a problem in fluid dynamics. Prerequisite: C.E. 562.

C.E. 570. Rural Sanitation Design (3) Requirements and devices essential to rural sanitary problems: water supply, excreta disposal, industrial waste treatment. Not intended for civil or sanitary engineering students. Prerequisites: Chem. 4, Phys. 285.

C.E. 571. Water Purification and Softening (3) Current methods of softening, disinfecting, and conditioning water for municipal and industrial use. Prerequisite: C.E. 70.

C.E. 572. Sewage Treatment (3) Modern methods of sewage treatment. Prerequisite: C.E. 70.

C.E. 573. Advanced Problems in Sanitary Engineering (3-10) Continuation of C.E. 474 on a graduate level. Prerequisite: C.E. 474.

C.E. 575. Advanced Industrial Waste Treatment (3) Techniques of industrial waste treatment; attendant stream pollution and stream self-purification factors. Prerequisite: C.E. 472 or 572.

C.E. 576. Water Treatment Plant Design (1-6) Design of works for treatment of water for municipal and industrial use. Prerequisite: C.E. 71.

C.E. 577. Sewage Treatment Plant Design (1-6) Design of works for treatment of sewage or industrial wastes. Prerequisite: C.E. 71.

C.E. 578. Industrial Hygiene (3) Principles of control of industrial toxics and the protection of the worker and the community.

C.E. 579. Public Health Administration (3) Operation and duties of health departments at the various levels.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

C.E. 401a,b,c,d. Civil Engineering Projects (2-12)
C.E. 412. Advanced Photogrammetry (3)
C.E. 421. Highways and Streets (3)
C.E. 422. Railroads (3)
C.E. 423. Highway Safety and Traffic Control (3)
C.E. 431. Civil Engineering Construction (3)
C.E. 441. Statically Indeterminate Structures (3)
C.E. 442, 442X. Statically Indeterminate Structures (3)
C.E. 443. Photoelasticity and Model Analysis (3)
C.E. 444, 444X. Soil Mechanics and Foundations (3)
C.E. 446. Advanced Soil Mechanics (3)
C.E. 451. Advanced Hydrology (3)
C.E. 462. Advanced Hydraulics (3)
C.E. 463. Hydraulic Laboratory Investigations (1-6)
C.E. 465. Applied Hydraulics (3)
C.E. 466. Hydraulic Machinery (3)
C.E. 471. Municipal and Rural Sanitation (3)
C.E. 472. Sewage and Industrial Wastes Treatment (3)
C.E. 473. Water and Sewage Analysis (3)
C.E. 474. Sanitary Engineering Problems (1-6)
C.E. 475. Water Treatment and Conditioning (3)
C.E. 481. Municipal Planning and Zoning (3)

CLOTHING AND TEXTILES

Professor Ruth E. Graham, M.S.
Head of the Department

Cl. Tex. 500. Research in Clothing or Textiles (1-6 per semester)

Cl. Tex. 501. Thesis (1-15)

Cl. Tex. 502. Tailoring (3) The construction of tailored garments for women and children from new or renovated materials. Prerequisites: Cl. Tex. 102, 201.
Professor Westgate

Cl. Tex. 503. Advanced Fitting and Pattern Study (3) Application of the principles involved in altering patterns and fitting garments to give students freedom

in designing and ability to deal with difficult fitting problems. Prerequisite: Cl. Tex. 201. *Professor Westgate*

Cl. Tex. 504. Advanced Dress Design (3) Draping of garments difficult in type and distinctive in design; survey of literature in dress design. Prerequisites: Art 56, Cl. Tex. 404.

Cl. Tex. 505, 505X. Clothing Instructional Materials (3) Preparation and evaluation of different types of materials for instruction in textiles and clothing. Prerequisite: Cl. Tex. 201.

Cl. Tex. 506. The Fashion World (3) The development of fashion throughout the ages; relationship of present-day fashions and practices to previous periods. Prerequisites: Cl. Tex. 102, 301. *Professor Graham*

Cl. Tex. 507. Problems in Relation to Clothing Consumption (3) Problems connected with the manufacture and consumption of clothing, interrelation of the textile and clothing trades with other industries. Prerequisite: Cl. Tex. 301. *Professor Graham*

Cl. Tex. 508. Special Problems in Clothing and Textiles (1-6) Individual directed study, investigation, and practice in selected phases of textiles and clothing. Prerequisites: Cl. Tex. 102, 201.

Cl. Tex. 509. Seminar in Clothing and Textiles (1-6) Discussion and reports on current research in clothing and textiles.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Cl. Tex. 401. Clothing Conservation (2-3)
Cl. Tex. 403. Fitting and Pattern Adjustment (3) *Professor Westgate*
Cl. Tex. 404. Dress Design (3)
Cl. Tex. 405, 405X. Fashion Merchandising (3)
Cl. Tex. 406. Fashion Promotion of Textiles and Clothing (3)
Cl. Tex. 407. The Textile and Clothing Industry (3)
Cl. Tex. 408. Textiles (3)
Cl. Tex. 409, 409X. Costume Selection (3)

COMMERCE

Professor William N. Leonard, A.M., Ph.D.
Head of the Department of Economics and Commerce

Com. 500. Case Studies in Business Administration (3) Case studies of business and management policy with respect to procurement, production, selling, finance, accounting, relations with government, labor, and the public. *Professor Waters*

COM. 501. COMMERCE SEMINAR (3-6) Reports on research in selected fields of commercial activities.

COM. 505. PROBLEMS OF CORPORATION FINANCE (3) The more important current problems of corporate financial policy, particularly problems of promotion, capitalization, security issue, valuation, administration of income, expansion, reorganization, and government control of policy. Prerequisites: Com. 5, 41.
Professor Leffler

COM. 515. TRANSPORTATION RATES AND BUSINESS (3) Rate making and rate changes and their effects on business location and development. Prerequisite: Com. 15. *Professor Waters*

COM. 517. INTERNATIONAL BUSINESS PRACTICES (3) Practices of exporters and importers dealing in commodities traded in world markets under competition, monopoly, or governmental control. Prerequisite: Com. 17. *Professor Hench*

COM. 523. SEMINAR IN MARKETING (3) Research in modern marketing trends.
Professor Hilgert

COM. 524. MARKETING POLICIES (3) Major problems of sales planning, organization, control, and supervision; current trends in merchandising policies of manufacturers; selection and training of salesmen, preparation of selling methods, sales budgets and sales quotas. Prerequisite: Com. 424. *Professor Hilgert*

COM. 525. CASE STUDIES IN INSURANCE (3) An analysis of management's insurance problems, such as the feasibility of self-insurance; proper allocation of insurance premiums and coverage in selected industries, etc. Prerequisites: Com. 25, 33.
Professor Wherry

COM. 526. PROBLEMS OF ADVERTISING (3) Advertising budgeting, selection of media, appraisal of effectiveness, co-ordination of advertising and selling efforts. Prerequisite: Com. 23. *Professor Hilgert*

COM. 536. PROBLEMS IN SALES MANAGEMENT (3) Principles of sales planning and administration; co-ordination of selling with advertising, promotion, production, and accounting; use of market research selling costs and budgets. Prerequisite: Econ. 1. *Professor Hilgert*

COM. 540. ACCOUNTING SEMINAR (3) Selected phases of accounting theory. Prerequisite: Com. 43. *Professor Rowland*

COM. 548. ACCOUNTING SYSTEMS (3) Principles of system design including practical application to special businesses, such as financial institutions, department stores, public utilities, etc. Prerequisite: Com. 442. *Professor Rowland*

COM. 550. REAL ESTATE PROBLEMS (3) Analysis of current real estate problems and practices for the broker, the business man, and the property owner; appraisal methods; property management; housing, and the legal, financial, economic, and social aspects of the real estate field. Prerequisite: Com. 50.

COM. 560. CASE STUDIES IN AMERICAN INDUSTRIES (3) The economic relationship of such factors as climate, resources, population, transportation and markets, and the location of enterprise. Prerequisite: Com. 60. *Professor Mares*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

COM. 401.	PURCHASING (3)	*Professor Babione*
COM. 402.	CONTROLLERSHIP (3)	*Professor Nelson*
COM. 405.	ANALYSIS OF FINANCIAL STATEMENTS (3)	*Professor Cook*
COM. 407.	INVESTMENT BANKING (3)	*Professor Bradley*
COM. 410.	BANK MANAGEMENT (3)	*Professor McKinley*
COM. 415.	REGULATION OF TRANSPORT CARRIERS (3)	*Professor Waters*
COM. 417.	FOREIGN MARKETS (3)	*Professor Hench*
COM. 423.	ADVERTISING PROCEDURE (3)	*Professor Decker*
COM. 424.	MARKETING RESEARCH (3)	*Professor Hilgert*
COM. 425.	INSURANCE AGENCY MANAGEMENT (3)	*Professor Wherry*
COM. 426.	STORE MANAGEMENT AND OPERATION (3)	*Professor Einstein*
COM. 427.	RETAIL BUYING AND MERCHANDISING (3)	*Professor Einstein*
COM. 428.	RETAIL ADVERTISING AND SALES PROMOTION (3)	*Professor Einstein*
COM. 429.	BUYING AND MERCHANDISING PROBLEMS (3)	*Professor Einstein*
COM. 430.	ADVANCED BUSINESS LAW (3)	*Professor Tanner*
COM. 431.	C. P. A. LAW REVIEW (3)	*Professor Tanner*
COM. 436.	FUNDAMENTALS OF SALES MANAGEMENT (3)	*Professor Hilgert*
COM. 442.	ADVANCED ACCOUNTING (3)	*Professor Lordeman*
COM. 443.	ADVANCED AUDITING (3)	*Professor Rowland*
COM. 444.	BUDGETARY CONTROL (3)	*Professor Nelson*
COM. 445.	ADVANCED COST ACCOUNTING (3)	*Professor Nelson*
COM. 447.	ADVANCED FEDERAL TAX ACCOUNTING (3)	*Professor Lordeman*
COM. 448.	C. P. A. REVIEW COURSE (3)	*Professor Rowland*
COM. 460.	MANUFACTURING INDUSTRIES (3)	*Professor Mares*
COM. 470.	PUBLIC RELATIONS IN BUSINESS (3)	*Professor Wherry*
COM. 475.	BUSINESS MANAGEMENT (3)	*Professor Stonier*

COMMERCIAL CONSUMER SERVICES

PROFESSOR MARY BROWN ALLGOOD, M.S.
Chairman of the Division

The following courses may be taken for graduate credit under the restrictions in force:

C. CON. S. 403.	LECTURE-DEMONSTRATION TECHNIQUES (3)	*Professor Allgood*
C. CON. S. 450.	PROBLEMS IN HOUSEHOLD EQUIPMENT (1-6)	*Professor Allgood*

DAIRY HUSBANDRY

PROFESSOR DONALD V. JOSEPHSON, M.S., Ph.D.
Head of the Department

D.H. 501. BUTTER AND CHEESE (1-6) The manufacture and handling of butter and cheese. Prerequisites: D. H. 10, 23, Bact. 8, Agr. Biochem. 403. *Professor Dahle*

D.H. 502. CONDENSED MILK AND MILK POWDER (1-6) The condensing and drying of milk. Prerequisites: D.H. 10, 26, Bact. 8, Agr. Biochem. 403. *Professor Doan*

D.H. 503. PUBLIC MILK PROBLEMS (1-6) The handling of milk in modern plants. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403. *Professor Doan*

D.H. 504. ICE CREAM MANUFACTURE (1-6) The manufacture of ice cream, ices, and other frozen milk products. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403. *Professor Dahle*

D.H. 505. DAIRY PLANT ECONOMICS (1-6) The economic factors involved in creamery operation and management. Prerequisites: D.H. 7, 11. *Professor Dahle*

D.H. 506. DAIRY CATTLE BREEDING (1-6) The improvement of dairy cattle, including methods of sire evaluation, systems of breeding, and the development of breeding programs. Prerequisite: D.H. 30. *Professor Almquist*

D.H. 507. DAIRY CATTLE MANAGEMENT (1-6) The management of dairy cattle. Prerequisite: D.H. 27. *Professor Williams and Staff*

D.H. 508. DAIRY SEMINAR (1-6) The preparation and presentation of a paper on an assigned subject. *Professor Josephson and Staff*

D.H. 509. TESTING DAIRY PRODUCTS (1-6) The constituents of dairy products. Prerequisites: D.H. 11, Bact. 8, Agr. Biochem. 403. *Professor Doan*

D.H. 510. DAIRY CATTLE FEEDING (1-6) The application of fundamental research in animal nutrition to the feeding of dairy cattle. Prerequisites: D.H. 1, 29. *Professor Williams*

D.H. 511. DAIRY CATTLE NUTRITION (1-6) The nutritional requirements of dairy cattle. Prerequisites: An. Nutr. 401, 402. *Professor Knodt and Staff*

D.H. 512. ADVANCED STUDIES IN MILK SECRETION (1-6) The physiology of milk secretion. Prerequisite: D.H. 427. *Professor Knodt*

D.H. 513. DAIRY CATTLE SELECTION (1-6) Breed history, pedigrees, selection and judging of dairy cattle. Prerequisites: D.H. 1, 30. *Professor Knodt and Staff*

D.H. 515. ADVANCED PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS (1-6) The reproduction of farm animals. *Professor Almquist*

D.H. 516. ARTIFICIAL BREEDING OF FARM ANIMALS (1-6) Prerequisite: D.H. 431. *Professor Almquist*

D.H. 517. Dairy Husbandry Literature (1-6) The review and reporting of dairy literature. *Professor Josephson and Staff*

D.H. 518. Thesis (1-15) *Professor Josephson and Staff*

D.H. 519. Research in Dairy Production (1-15 per semester) *Professor Josephson and Staff*

D.H. 520. Research in Dairy Manufacturing (1-15 per semester) *Professor Josephson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

D.H. 418. Dairy Survey (1) *Professor Josephson*
D.H. 421. Dairy Manufacturing Problems (1-6) *Professors Dahle, Doan, and Staff*
D.H. 427. Milk Secretion (3) *Professor Knodt*
D.H. 428. Dairy Production Problems (1-3) *Mr. Dawdy and Staff*
D.H. 429. Testing Dairy Products (1-6) *Mr. Davey*
D.H. 430. Technical Control of Dairy Products (4) *Mr. Watrous*
D.H. 431. Physiology of Reproduction in Farm Animals (3) *Professor Almquist*

DRAMATICS

Consult Professor Arthur C. Cloetingh, M.A.

Dram. 501. Problems of Directing (3-6) Seminar in problems of production with particular stress on direction. Students will direct plays under staff supervision.

Dram. 502. Seminar in the Technical Problems of Dramatic Production (3) Prerequisite: Dram. 11.

Dram. 503. Art of Dramatic Lighting (3) Seminar in stage lighting; advanced study in the theory of lighting as used for dramatic effectiveness. Practical work required of each student. Prerequisite: Dram. 12.

Dram. 504. Seminar in Styles of Acting (3-6) Practical work required of each student.

Dram. 506. Evaluation and Appreciation of Modern Dramatic Entertainment (3) Prerequisites: Dram. 1, 61.

Dram. 507. Seminar in Fundamental Theories of Theater and Drama (3-6)

Dram. 521. Playwriting (3-6) Prerequisites: Dram. 21, 421.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Dram. 403. Advanced Make-Up (1)

DRAM. 411. TECHNICAL PRODUCTION (3)
DRAM. 412. DRAMATIC DESIGN (3)
DRAM. 413. ADVANCED STAGE LIGHTING (3)
DRAM. 421. ADVANCED PLAYWRITING (3)
DRAM. 431. HISTORY OF THE THEATER (3)
DRAM. 442S. EDUCATIONAL DRAMATICS (3)
DRAM. 443S. EDUCATIONAL DRAMATICS (ADVANCED MARIONETTES) (3)
DRAM. 451. DIRECTING (3)
DRAM. 470. DRAMATICS IN THE SCHOOLS (3)
DRAM. 480. RADIO DRAMA (3)
DRAM. 481. ADVANCED RADIO DRAMA (3)

ECONOMICS

PROFESSOR WILLIAM N. LEONARD, A.M., Ph.D.

Head of the Department of Economics and Commerce

ECON. 500. ECONOMICS SEMINAR (3-6)

ECON. 501. RESEARCH METHODS IN ECONOMICS (3-6) *Professor Leonard*

ECON. 502. VALUATION OF PUBLIC UTILITIES (3) *Professor Cook*

ECON. 505. TRANSPORTATION SEMINAR (3) Prerequisite: Com. 15. *Professor Waters*

ECON. 507. INTERNATIONAL ECONOMIC RELATIONS (3) *Professor Hench*

ECON. 508. SEMINAR IN MONEY AND BANKING (3-6) Prerequisite: Econ. 51. *Professor McKinley*

ECON. 509. TAXATION PROBLEMS (3) *Professor Stout*

ECON. 510. DEMAND ANALYSIS (3) *Professor Mendelson*

ECON. 511. ECONOMIC BASES FOR CONTROL OF INDUSTRIAL DISPUTES (3) Prerequisites: Econ. 1 or 14; 15. *Professor Myers*

ECON. 515. LABOR SEMINAR (3) *Professor Reede*

ECON. 520. ADVANCED ECONOMIC STATISTICS (3) Prerequisites: 6 credits in economics and 3 in statistics. *Professor Saylor*

ECON. 522. ADVANCED ECONOMIC THEORY (3) The theory of price and the allocation of scarce resources in the production of goods and services demanded. Prerequisites: Econ. 2, 405.

ECON. 523. ADVANCED ECONOMIC THEORY (3) The theory of income determination (national income) as a method of explaining variations in "output as a whole." Prerequisite: Econ. 522.

ECON. 542. SEMINAR IN PUBLIC POLICY AND ECONOMIC STRUCTURE (3-6) *Professor Leonard*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ECON. 400.	HISTORY OF ECONOMIC THOUGHT (3)	*Professor Senn*
ECON. 401.	EUROPEAN ECONOMIC THOUGHT (3)	*Professor Senn*
ECON. 405.	INTERMEDIATE ECONOMIC THEORY (3)	*Professor Leonard*
ECON. 407.	AMERICAN ECONOMIC THOUGHT (3)	*Mr. Levinson*
ECON. 409.	THEORY OF INTERNATIONAL TRADE (3)	*Professor Reedy*
ECON. 410.	ECONOMICS OF CONSUMPTION (3)	*Professor Keyes*
ECON. 411.	ECONOMICS OF LABOR RELATIONS (3)	*Professor Myers*
ECON. 412.	ECONOMICS OF COLLECTIVE BARGAINING (3)	*Professor Luchek*
ECON. 415.	SOCIAL INSURANCE (3)	*Professor Reede*
ECON. 416.	MANAGEMENT OF LABOR RELATIONS (3)	
ECON. 417.	INTERNATIONAL COMMERCIAL POLICIES (3)	*Professor Reedy*
ECON. 418.	ECONOMICS OF WAGES AND EMPLOYMENT (3)	*Professor Sharpe*
ECON. 419.	CASE STUDIES IN LABOR-MANAGEMENT RELATIONS (3)	*Professor Reede*
ECON. 421.	CENTRAL AND INTERNATIONAL BANKS (3)	*Professor McKinley*
ECON. 423.	PENNSYLVANIA LOCAL FINANCE (3)	*Professor Stout*
ECON. 424.	PENNSYLVANIA STATE FINANCE (3)	*Professor Stout*
ECON. 425.	THE MONEY MARKET (3)	*Professor McKinley*
ECON. 426.	FISCAL POLICY (3)	*Professor Levin*
ECON. 427.	MONETARY THEORY AND POLICY (3)	*Professor Senn*
ECON. 430.	NATIONAL PLANNING (3)	*Professor Keyes*
ECON. 431.	HOUSING AND COMMUNITY DEVELOPMENT (3)	*Professor Keyes*
ECON. 433.	INTERNATIONAL MONETARY ECONOMICS (3)	*Professor Reedy*
ECON. 435.	PROBLEMS OF FEDERAL FINANCE (3)	*Professor Stout*
ECON. 440.	ECONOMIC INSTITUTIONS OF CAPITALISM (3)	
ECON. 450.	THE BUSINESS CYCLE (3)	*Professor Leonard*
ECON. 460.	LOCATION OF ECONOMIC ENTERPRISE (3)	*Professor Mares*
ECON. 480.	MATHEMATICAL ECONOMICS (3)	*Professor Mendelson*
ECON. 490.	MEASUREMENT OF THE ECONOMY (3)	*Professor Saylor*
ECON. 491.	ADVANCED BUSINESS STATISTICS (3)	*Professor Saylor*
ECON. 492.	DEMOGRAPHIC STATISTICS (3)	*Professor Saylor*
ECON. 499X.	FOREIGN STUDY IN ECONOMICS (2-6)	

EDUCATION

PROFESSOR CHARLES M. LONG, M.A., D.Ed.
Head of the Department

ED. 501. INTRODUCTION TO THE ADVANCED STUDY OF EDUCATION (1-3) Methods of educational research; criticism of studies and theses in education; initiating research projects; summarizing the results of research. Prerequisite: Ed. 470 or Psy. 415. *Professor Davison*

Ed. 502. Supervised Experience in Student Counseling (3) Practice in the application of guidance principles and methods to cases counseled under supervision; case conferences; seminar in guidance techniques. Prerequisite: Ed. 453.
Professor Wellington

Ed. 503. Supervision of Guidance Workers (3) Practical experience in supervising and evaluating the work of counselors. Prerequisite: Ed. 502.
Professor Wellington

Ed. 504. Organization and Administration of Guidance Programs (3) Principles, organization, personnel, functions, integration with school program, evaluation. *Professor Wellington*

Ed. 505. Occupational and Educational Information (3) Occupational information for guidance purposes, educational information related to vocational choice and preparation. Prerequisite: Ed. 453. *Professor Wellington*

Ed. 506. Developing Analyses of the Individual for Vocational Counseling (3) Collection and use of data basic to the counselor's understanding of individuals; the counseling interview and techniques other than testing.
Professor Wellington

Ed. 515. Comparative European Education (3) Educational policies and practices in school systems in western and central European nations. Prerequisite: Psy. 14. *Professor Champlin*

Ed. 516. Social Foundations of the Curriculum (2-4) Analysis of societal needs as a basis for educational programs; contributions of public education to social advancement. Prerequisites: Ed. 25, Psy. 14. *Professor McNerney*

Ed. 517. Evolution of Educational Thought (2-3) Rise of formal educational philosophy from Plato to John Dewey; preliminary reference to Chinese, Hindu, Chaldean, Persian, Hebrew, and Egyptian theories. *Professor Champlin*

Ed. 522. Production of Educational Moving Pictures (1-3) Nonlaboratory course on production techniques from the sponsor's viewpoint; script writing; photography, editing, sound recording. Prerequisites: Ed. 424, 487 (Unit B). Conference 1 hour, alternate weeks by appointment. *Professor VanderMeer*

Ed. 523. Laboratory in Organizational Aspects of Materials of Instruction (1-3) Organizing, storing, circulating, and maintaining instructional materials in an instructional materials library. Prerequisites: Ed. 424, 585. Conference 1 hour, alternate weeks by appointment. *Professor VanderMeer*

Ed. 524. Seminar in Curriculum Materials and Their Utilization (3) Advanced detailed analysis of mass communication media; relationships among these and educational objectives, individual differences in learners, and ideas to be communicated. Prerequisites: Ed. 424, 585, 6 hours of educational psychology.
Professor VanderMeer

Ed. 525. Modern Tendencies in Educational Method (2-3) Study of science supporting dynamic instruction; principles of teaching as guides; analysis of modern procedures; understanding of learning; substance versus plans. Prerequisite: 12 semester hours of undergraduate work in education. *Professor Butler*

Ed. 527. Problems in the Education of the Mentally Retarded (1-4) Study of existing curricula, instructional practices, educational programs; experimentation in curriculum building and materials construction. Prerequisites: Ed. 426 or 583, Unit P, and Ed. 427 and teaching experience. *Professor Neuber*

Ed. 529. Problems in the Education of the Mentally Gifted (1-4) Analysis of educational needs of mentally gifted; curriculum construction and curricular materials. Prerequisites: teaching experience and Ed. 426 or 583, Unit P, and 429. *Professor Neuber*

Ed. 532. Supervision of Student Teachers (3) A course in supervision for master teachers, department heads, and college teachers with supervisory responsibilities in teacher education. Prerequisite: experience in teaching and 18 credits in education, including at least 5 in methods. *Professor Moyer*

Ed. 534a. Reading Clinic Practice: Analysis of Reading Disabilities (1-9) A laboratory course consisting of analysis of extreme reading disabilities and recommended remedial procedures; experience in preparation of case reports. Prerequisite: Ed. 432g or Psy. 550.

Ed. 534b. Reading Clinic Practice: Remedial Procedures (1-9) Practicum in special classes for reading disabilities; corrective and remedial procedures; specific procedures for correction of various types of reading disabilities. Prerequisite: Ed. 432g or 534a.

Ed. 535. Seminar on Reading Instruction (2-12) Designed to appraise significant researches and to outline procedures and materials for research; reading readiness, word perception, basic reading skills, vocabulary development. Prerequisite: Ed. 432b or 432c. *Professor G. E. Murphy*

Ed. 536. Reading Clinic Research (1-15) Prerequisites: Ed. 432b; or Ed. 432c, 432g. *Professor G. E. Murphy*

Ed. 540. Problems of Elementary Education (2-3) A problems seminar for experienced educators. Prerequisite: 12 credits in education and psychology, including 6 in elementary education. *Professor Long*

Ed. 541. Seminar in Contemporary Issues in Elementary Education (1-3) Conferences and discussions designed to meet the needs of experienced teachers and principals in the field of elementary education. Prerequisite: 6 credits in elementary education and teaching experience.

Ed. 546. Elementary School Principal as Supervisor (2-3)

Ed. 548. Organization of the Elementary School Curriculum (2-3) Principles underlying curriculum construction. Primarily for elementary education majors. Prerequisite: Ed. 31 or teaching experience.

ED. 550. PROBLEMS IN MODERN SECONDARY EDUCATION (1-4) Historical, psychological, social, and economic factors influencing secondary education; required as basic course of all graduate students in secondary education. Prerequisite: Ed. 450 or secondary school teaching. *Professor Butler*

ED. 551. SEMINAR IN CONTEMPORARY ISSUES IN SECONDARY EDUCATION (2-9) *Professor Moyer*

Unit A. The Secondary School Curriculum (2-3) Principles and philosophy of curriculum construction. Each student works out an individual problem in the secondary school curriculum. Prerequisites: 12 credits in education and psychology, and teaching experience.

Unit B. Laboratory Studies in Application of Educational Method (2-3) Analysis and application of outstanding studies in secondary education; integration of results of educational research with public school procedures. Prerequisites: 12 credits in education and psychology, and teaching experience.

Unit C. Organization and Administration of Secondary Education (2-3) Problems in the reorganization of secondary education, with particular reference to philosophy, organization, and teaching problems of the junior high school. Prerequisites: 12 credits in education and psychology, and teaching experience.

ED. 556. THE SECONDARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3) Improvement of instruction; improvement of teachers in service; evaluation of teaching procedures; methods of supervision; selection and use of textbooks. Prerequisite: three years' teaching experience. *Professor Wyland*

ED. 561. THE COMMUNITY COLLEGE AND POST-SECONDARY SCHOOL EDUCATION (2-3) The philosophy, organization, and character of school programs needed to meet the educational needs of individuals who desire to continue their education on the post-secondary school level. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience. *Professors Patrick and Ehmann*

ED. 562. THE INSTRUCTIONAL PROGRAM IN COMMUNITY COLLEGES AND POST-SECONDARY EDUCATION (2-3) Course offerings, curricula, instructional materials and procedures, guidance, extracurricular activities, student personnel, evaluation of results, and faculty qualifications. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience. *Professors Patrick and Ehmann*

ED. 563. THE PROFESSIONAL EDUCATION OF TEACHERS (3) Development and present status of teacher education; objectives and standards; selection and guidance of students; personnel problems in relation to staff. Prerequisite: 6 credits in advanced courses in education and a course in educational psychology.

ED. 564. RECENT TRENDS IN HIGHER EDUCATION (2-3) Factors affecting current college enrollment, organization, administration, support, and curricula, with special emphasis on general education, its development, aims, and forms. *Professor Ehmann*

Ed. 565. The Principles of College Teaching (2-3) Principles involved in teaching at the college level; effective use of teaching aids; criteria used in evaluation.

Ed. 566. Student Personnel Programs at the College Level (2-3) Student personnel services in higher education; organization of student advisory programs; use of personnel data; co-curricular activities; student welfare.

Ed. 567. Growth and Organization of Higher Education (2-3) Growth of higher education; influence of church, state, federal government; educational, social, and economic factors that have affected curricula and organization of institutions. *Professor Ehmann*

Ed. 568. Curricula in Higher Education (2-3) Various types of curricula and philosophies underlying them; ways in which curricula are developed; elective versus required courses; evaluation of achievement. *Professor Ehmann*

Ed. 569. Seminar in Collegiate Education (1-6) Special topics in higher education. Prerequisite: Ed. 567. *Professor Weaver*

Ed. 574. Advanced Educational Statistics (2-4) Appropriate measures and devices for experimental research in education including correlation measures, curve fitting, and the analysis of variance. Prerequisite: 12 credits of graduate work in education including Ed. 470 or Psy. 415. *Professor Davison*

Ed. 575. Administration and Supervision in Business Education (3) Work of administrators, supervisors, and others responsible for improvement of instruction in business education; use of vocational testing; job analysis. Prerequisite: 6 credits in secondary education. *Professor Gemmell*

Ed. 576. Introduction to Research in Business Education (3) Methods of research in business education; opportunity to compile annotated bibliographies on current problems; analysis and evaluation of significant research. *Professor Gemmell*

Ed. 577. Evaluation of Research and Empirical Literature in Business Education (3) Application of evaluation methods to current literature in business education; special attention to research studies. Prerequisite: Ed. 576. *Professor Gemmell*

Ed. 578. Seminar in Business Education (3) Intended for graduate students preparing theses or final documents, or for those working on special studies in business education. Prerequisite: Ed. 577. *Professor Gemmell*

Ed. 580. Seminar in School Administration (1-6) Efficiency in supervision, methods of diagnosis and evaluation of teaching and learning procedure, improving instruction, maintaining teacher morale, stimulating co-operative work. Prerequisite: Ed. 480, 6 credits of Ed. 583. *Professor Aurand*

Ed. 582. Educational Survey Techniques (2-3) Methods for the appraisal of an educational program; planning for expansion, consolidation, or reduction of educational offerings. Prerequisites: Ed. 480, 6 credits of Ed. 583. *Professor Davison*

Ed. 583. Problems in Administration and Supervision (2-21) Prerequisite: Ed. 480 or teaching or administrative or supervisory experience.
Professor Aurand and Staff

Unit A. The Educational Plant (2)
Unit B. Public Relations for School Administrators (2-3)
Unit C. Public School Finance (2-3)
Unit I. Administration of Adult Education in the Public Schools (3)
Unit M. Legal Aspects of School Administration (3)
Unit P. The Administration of Public School Education for Atypical Children (2)
Unit Q. Dynamic Factors in School Administration (2)
Unit R. Public School Business Administration (2-3)

Ed. 585. Curriculum Construction (2-3) Functions of administrators, supervisors, teachers, pupils, laymen in curriculum building to meet pupil and community needs.

Ed. 586. Principles of School Supervision (2-3) Organization of supervision; planning the supervisory program; developing standards of teaching and learning; improvement of learning through tests and teacher rating. Prerequisites: 18 credits in education and 3 years' teaching experience.

Ed. 587. The Secondary School Principal as Administrator (2-4) Problems of schedule making, teachers' meetings, curriculum making and revision, organization of extracurricular and guidance programs. Prerequisite: teaching experience.
Professor Wyland

Ed. 589. The Elementary School Principal as Administrator (2-3) The duties of the elementary school principal in organizing and administering his school. Prerequisite: Ed. 442.

Ed. 590. The Philosophy of Education (2-4) Fundamental principles; scientific sanctions of progressive instructional practices and professional experiences as bases for formulation of the educational creed. Prerequisite: 18 credits in education.
Professor Champlin

Ed. 591. Education in Russia, Asia, and the Middle East (2-3) Current educational activities in Soviet Russia and other eastern European countries; the Middle East, North Africa, and the Far East.

Ed. 592. Education in the Latin-American Countries (2-3) Recent educational progress in Central and South America, with special reference to Mexico, Cuba, Puerto Rico, Brazil, Chile, and Argentina.

Ed. 594. Seminar in Education (1-6) Conferences and discussions designed to meet the need for special study of particular fields in education. Prerequisite: 12 credits of graduate work in education.
Professors Long and Davison

Ed. 595. Educational Research (1-15) An inductive research from primary sources expected to maintain standards sufficiently high to warrant publication of

the findings. Prerequisite: at least 6 hours of graduate study in education, including some work in statistics.

Ed. 597S. Workshop in Current Educational Problems (1-6) For administrators, supervisors, experienced elementary and secondary teachers, guidance workers; administrative, supervisory, and instructional problems involved in an emerging educational program. Prerequisite: 12 credits of graduate work in education.
Professor Wyland

Ed. 599. Thesis (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Ed. 413, 413X. History of Education in the United States (2-3)
Professor Champlin
Ed. 415S, 415X. Modern Tendencies in American Education (1-6)
Ed. 416X. Social Education (3)
Ed. 421X. Modern Tendencies in Educational Method (2-3)
Ed. 424, 424X. Visual and Other Sensory Aids for Teachers (1-3)
Professor VanderMeer
Ed. 425S, 425X. The Scientific Direction of Learning Activities (2-4)
Ed. 426, 426X. Education of Exceptional Children (2-3) *Professor Neuber*
Ed. 427. Education of the Mentally Retarded (2-3) *Professor Neuber*
Ed. 428, 428X. Units A, B, C. Adult Education: Organization, Types, and Methods (1-3) *Professor Cologne*
Ed. 429, 429X. Education of the Mentally Gifted Child (1-3)
Professor Neuber
Ed. 430, 430X. Visual and Other Aids in Safety Education (3)
Ed. 431, 431X. Principles and Methods of Teaching Safety Education (3)
Ed. 432b, 432bX. The Elementary School Reading Program (2-3)
Professor G. E. Murphy
Ed. 432c, 432cX. Reading Problems in the Secondary School (2-3)
Professor G. E. Murphy
Ed. 432d, 432dX. Special Problems in the Teaching of Elementary School English (2-3) *Professor G. E. Murphy*
Ed. 432eX. Choral Speaking (3) *Professor G. E. Murphy*
Ed. 432f, 432fX. Teaching Secondary School English (2-3)
Professor G. E. Murphy
Ed. 432g, 432gX. Reading Disabilities (2-3) *Professor Hunt*
Ed. 432h, 432hX. Techniques in Remedial Reading (2-6) *Professor Hunt*
Ed. 433e. Advanced Theory of Kindergarten (3) *Professor Graffius*
Ed. 433f, 433fX. Teaching Children's Literature (2-3)
Professor G. E. Murphy
Ed. 433h, 433hX. Problems of Elementary School Arithmetic (2-3)
Professor Neuber
Ed. 433n, 433nX. Teaching Social Studies in the Elementary Grades (2-3)
Professor Taylor

ED. 433w, 433wX. TEACHING SOCIAL STUDIES IN THE HIGH SCHOOL (2-3) *Professor VanderMeer*

ED. 433y, 433yX. TEACHING MATHEMATICS IN THE SECONDARY SCHOOL (3)

ED. 435X. EDUCATION FOR CITIZENSHIP (2-3) *Professor Champlin*

ED. 438, 438X. TEACHING SCIENCE IN SECONDARY SCHOOLS (2-3) *Professor Free*

ED. 438e, 438eX. TEACHING SCIENCE IN THE ELEMENTARY SCHOOL (1-3) *Professor Elzey*

ED. 439, 439X. TEACHING TRAFFIC SAFETY AND AUTOMOBILE OPERATION (1-3) *Professor Neyhart, Mr. Intorre*

ED. 441X. PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS (2-3)

ED. 442, 442X. ELEMENTARY EDUCATION (2-3)

ED. 446. DIAGNOSIS OF ATTAINMENT (3)

ED. 448X. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3)

ED. 449aS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE ELEMENTARY SCHOOL (3) *Professor Free*

ED. 449bS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE SECONDARY SCHOOL (3) *Professor Free*

ED. 450X. SECONDARY EDUCATION (2-3) *Professor Butler*

ED. 451X. SPECIAL PROBLEMS OF THE HIGH SCHOOL TEACHER (2-3)

ED. 453, 453X. GUIDANCE PRINCIPLES AND PRACTICES (3)

ED. 454, 454X. EXTRACURRICULAR ACTIVITIES IN THE JUNIOR AND SENIOR HIGH SCHOOL (2-3) *Professors Moyer and Patrick*

ED. 456, 456X. PRINCIPLES AND PROBLEMS IN BUSINESS EDUCATION (1-3) *Professors Gemmell and Veon*

ED. 459, 459X. IMPROVEMENT OF INSTRUCTION IN BUSINESS SKILL SUBJECTS (1-3) *Professor Gemmell*

ED. 460. CURRICULA IN BUSINESS EDUCATION (3) *Professor Gemmell*

ED. 461. IMPROVEMENT OF INSTRUCTION IN BASIC BUSINESS SUBJECTS (3) *Professor Gemmell*

ED. 462. TEACHING SHORTHAND AND TYPEWRITING (3) *Professor Gemmell*

ED. 463. TEACHING OF BOOKKEEPING (3) *Professors Gemmell and Veon*

ED. 464. METHODS OF TEACHING DISTRIBUTIVE EDUCATION (3)

ED. 466. TEACHING OF OFFICE PRACTICE (3) *Professor Veon*

ED. 467. TEACHING OF SHORTHAND (2-3) *Professor Veon*

ED. 468. TEACHING OF TYPEWRITING (2-3) *Professor Veon*

*ED. 470, 470X. EDUCATIONAL MEASUREMENTS (2-3) *Professor Davison*

ED. 474, 474X. TEACHING AND GROUP GUIDANCE ABOUT OCCUPATIONS (3)

ED. 480, 480X. EDUCATIONAL ADMINISTRATION (2-3) *Professors Miller and Remaley*

ED. 482X. SUPERVISION AND IMPROVEMENT OF INSTRUCTION (2-3)

ED. 485X. CURRICULUM CONSTRUCTION (2-3)

ED. 487, 487X. PROBLEMS IN VISUAL AND OTHER SENSORY AIDS IN EDUCATION (1-12) Unit A (1-3), Unit B (1-2), Unit C (1-2), Unit D (1-2), Unit E (3) *Professor VanderMeer*

ED. 490X. PHILOSOPHY OF EDUCATION (3) *Professor Champlin*

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* No credit if credit has been received for Ed. 70.

Ed. 491X. School Law (3)
Ed. 493, 493X. Character Education and Guidance (2-3) *Professor Champlin*
Ed. 494. Religious Education (2-3)
Ed. 495S. Family Health and Human Relations (3-9)
Ed. 497S, 497X. Workshop in Selected Studies in Elementary and Secondary Education (1-6) *Professor Wyland and Staff*
Ed. 498, 498X. Practicum in the Education of Atypical Children (3-6) Unit A (3), Unit B (3), Unit C (3), Unit D (3), Unit E (3)
Ed. 499, 499X. Problems of Special Education (3) *Professor Neuber*

ELECTRICAL ENGINEERING

Professor Arthur H. Waynick, B.S., M.S., Sc.D.
Head of the Department

E.E. 520. Seminar (1) Required of all graduate students in electrical engineering. Conferences, reading, and presentation of technical papers.

E.E. 521a,b,c,d. Alternating-Current Theory (2-12) Special problems in alternating-current theory and the application of these problems to alternating-current circuits or machinery at any frequencies.

E.E. 523. Transients in Linear Systems (3) Transient response of linear electric circuits and electromechanical systems including the application of operational methods of analysis to electrical and electromechanical problems. Prerequisite: E.E. 423. *Professor Holt*

E.E. 524. Engineering Electronics (3) Special problems dealing with the design and application of electronic devices and systems; emphasis upon individual projects closely related to other phases of the student's graduate program.
Professor Stavely

E.E. 525. Symmetrical Components (3) Polyphase circuits and machines under unbalanced conditions of operation including the effects of rotating machines upon the distribution and transmission system performance; characteristics of phase converters and single-phase operation of polyphase systems. Prerequisite: E.E. 425.
Professor Holt

E.E. 528. Servomechanisms (3) An advanced treatment of the transient and steady-state behavior of closed-cycle control systems with special attention to stability and the design of stabilizing controllers. Prerequisite: E.E. 428.
Professor Tarpley

E.E. 530. Audio Frequency Engineering (3) Electrical systems and equipment used in production, recording, amplification, transmission, and measurement of sound. Prerequisite: E.E. 11 or 13. *Professor Hall*

E.E. 531a,b,c. Radio Frequency Engineering (3-9) Radio frequency equipment, measurements, and systems; amplifiers, modulators, demodulators, transmitters, receivers, transmission lines, antennae, and radiators. Prerequisite: E.E. 431.
Professor Hall

E.E. 532. Ultra-High-Frequency Engineering (4) Theory of transmission lines, wave guides, resonant cavities, antennae, and wave propagation. Prerequisite: E.E. 432. *Professor Hall*

E.E. 533. Automatic Control Systems (2-3) Automatic control, telemetering, and recording of electrical, mechanical, thermal, and chemical quantities. Prerequisite: E.E. 4. *Professor Rice*

E.E. 535. Engineering Analysis (3) The engineering applications of complex variables, conformal mapping methods and potential plotting, Laplace transform methods and stability criteria. Prerequisite: E.E. 435. *Professor Davids*

E.E. 538. Electromagnetic Engineering (3) Electrical and magnetic fields, using the Maxwell-Lorentz equations as applied to vector fields and special solutions for antennae, wave guides, and other engineering applications. Prerequisite: E.E. 438. *Professor Van Meter*

E.E. 550. Communication Networks (3) Methods of filter design using lattice networks; the effects of dissipation on the characteristics of filter networks; transient response of networks and the design of equalizers. Prerequisite: E.E. 450. *Professor Tarpley*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

E.E. 421a,b,c,d. Electrical Engineering Problems (2-12)
E.E. 423. Transient Phenomena (3) *Professor Holt*
E.E. 424. Engineering Electronics (3) *Professors Smith and Shields*
E.E. 425. Symmetrical Components (3) *Professor Holt*
E.E. 428. Servomechanisms (3) *Professor Tarpley*
E.E. 431. Vacuum-Tube Circuits (3) *Professor Van Meter*
E.E. 432. Ultra-High-Frequency Techniques (3) *Professor Hall*
E.E. 434. Industrial Electronics (3) *Professor Stavely*
E.E. 435, 435X. Engineering Analysis (3) *Professor Tarpley*
E.E. 438. Fundamentals of Electric Waves (3)
E.E. 450, 450X. Electrical Network Theory (3) *Professor Tarpley*
E.E. 460. High-Voltage Engineering (3) *Professor Armington*

ENGINEERING

Consult Dean Eric A. Walker, B.S., M.S., Sc.D.

The following courses may be taken for graduate credit under the restrictions in force:

Eng. 400. Production Engineering (3)
Eng. 410. Nuclear Engineering (3)

ENGINEERING EXPERIMENT STATION

PROFESSOR ELMER R. QUEER, B.S., M.S.
Assistant Director

ENG. EXP. STA. 501. FUEL INJECTION AND COMBUSTION IN DIESEL ENGINES (2-6) Characteristics and efficiency of various injection systems. *Professor Stanley*

ENG. EXP. STA. 504. FUEL SPRAY LABORATORY (3) A laboratory study of fuel injection for the Diesel engine. *Professor Stanley*

ENG. EXP. STA. 507. SCAVENGING OF TWO-STROKE CYCLE ENGINES (3) Design of ports, valves, blowers, intake and exhaust manifolds for proper scavenging and charging of engines, particularly two-stroke cycle Diesel engines; experimental technique in evaluating scavenging. Prerequisite: M.E. 413. *Professor Schweitzer*

ENG. EXP. STA. 508. FUEL FEEDING DEVICES FOR INTERNAL COMBUSTION ENGINES (3) Carburetors and injection equipment for Otto and Diesel engines and for liquid-fuel turbines, including the required control devices. *Professor Meyer*

ENG. EXP. STA. 509. ENGINEERING RESEARCH (3-15 per semester) Research in the various fields of activity of the department under the guidance of members of the staff.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ENG. EXP. STA. 401. THEORY OF ENGINEERING INSTRUMENTS (2-3)
Professor DeJuhasz

ENGINEERING MECHANICS

PROFESSOR JOHN A. SAUER, M.S., Ph.D.
Head of the Department

MCHS. 500. ADVANCED MECHANICS OF MATERIALS (3-6) Strain energy methods; special problems in bending and torsion; curved bars, beams on elastic foundations; thick-walled cylinders, shrink-fit assemblies, and rotating discs; thin-walled pressure vessels; bending of thin plates; buckling of bars and plates. Prerequisite: Mchs. 13.
Professor Marin

MCHS. 504. APPLIED ELASTICITY (3) Analyses of stress and strain in two dimensions; problems in elasticity and elastic stability; emphasis on applications to machine and structural design. Prerequisite: Mchs. 13. *Professors Marin and Sauer*

MCHS. 506. EXPERIMENTAL STRESS ANALYSIS (3) Experimental methods of stress determination including photoelasticity, stress coat and electric strain gauge techniques; stress analogies; strain rosettes for combined stress determinations. Prerequisite: Mchs. 13. *Professor Marin*

MCHS. 507. THEORY OF ELASTICITY AND APPLICATIONS (3-6) General equations of stress and strain; applications to beams, curved members, rotating disc, thick cylinders, torsion members, plates, and other structural and machine parts. Prerequisite: Mchs. 13. *Professors Sauer and Hardenbergh*

MCHS. 508. THEORY OF ELASTIC STABILITY AND APPLICATIONS (3) Buckling of slender and short members; buckling of I-beams; stability of thin-walled constructions; thin-walled cylinders subjected to internal pressures; applications to structural parts including aircraft members. Prerequisites: Mchs. 12, 13.

MCHS. 509. THEORY OF PLATES AND SHELLS (3) Bending of circular and rectangular plates; buckling of plates; plates on elastic foundations; deformation of shells without bending; applications to engineering problems. Prerequisite: Mchs. 13. *Professor Davids*

MCHS. 513. THESIS (1-9)

MCHS. 514. ENGINEERING MECHANICS SEMINAR (1 per semester) Current literature and special problems in engineering mechanics. *Professor Roos*

MCHS. 515. RESEARCH IN ENGINEERING MECHANICS (1-15 per semester) Investigation of a theoretical or experimental project in engineering mechanics.

MCHS. 520. ADVANCED DYNAMICS (3) Dynamics of a particle and of rigid bodies; Newtonian equations in moving co-ordinate systems; LaGrange's and Hamilton's equations of motion; special problems in vibrations and dynamics. Prerequisites: Mchs. 12, Math. 84 or 431. *Professor Sauer*

MCHS. 522. THEORY OF VIBRATIONS (3) Mathematical theory of vibrating systems; damping phenomena; forced vibrations; analogy between mechanical and electrical vibrations; transverse and torsional oscillation of shafts; vibration of strings, beams, membranes, and plates. Prerequisites: Mchs. 13, Math. 84 or 431. *Professors Sauer and Vierck*

MCHS. 523. RELAXATION METHODS (3) Relaxation methods compared to iteration and other numerical methods of analysis; application to elasticity, plasticity, stability, fluid flow, heat transfer, and related fields. Prerequisite: Mchs. 522. *Professor Vierck*

MCHS. 524. MATHEMATICAL METHODS IN ENGINEERING (3) Matrix and tensor analysis, finite differences, relaxation, perturbation, and other approximate methods in the solution of various engineering problems. Prerequisite: Math. 451 or E.E. 435 or M.E. Des. 404. *Professors Davids, Lessen, and Sauer*

MCHS. 530. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) True stress-strain relations in tension; plastic stress-strain equations for combined stresses; theories of failure for static and fatigue stresses; impact loads; creep of metals; applications to structural and machine design. Prerequisite: Mchs. 14. *Professor Marin*

MCHS. 531. THEORY OF PLASTICITY AND APPLICATIONS (3) Theory of plasticity including plastic torsion and bending of bars; thick-walled cylinders and rotating

discs; buckling of bars and residual stresses; mechanics of creep. Prerequisite: Mchs. 504 or 507. *Professor Marin*

Mchs. 533. Determination of Mechanical Properties (3) Experiments in fatigue, creep, impact, and combined stresses; true stress-strain diagrams. *Professor Roos*

Mchs. 540. Mechanics of Continua (3) A unified mathematical treatment of the elements of fluid mechanics and of the elasticity and plasticity of solids. Prerequisite: Math. 84 or 431. *Professor Lessen*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Mchs. 400. Advanced Strength of Materials (3) *Professors Marin and Hardenbergh*

Mchs. 401, 401X. Elements of Vibrations (3) *Professors Vierck and Sauer*

Mchs. 402. Applied and Experimental Stress Analysis (3) *Professor Marin*

Mchs. 403. Mechanical Properties of Materials and Design (3) *Professor Marin*

Mchs. 404. Research in Engineering Mechanics (1-6)

ENGLISH

Professor Theodore J. Gates, M.A.
Head of the Department of English Composition

Professor Brice Harris, M.A., Ph.D.
Head of the Department of English Literature

Engl. 501. Materials and Methods of Research (3) The bibliography of literary history and criticism; methods of editing and annotating texts; the form and materials of dissertations. Required of all graduate students with an English major. *Professor Ridenour*

Engl. 502. Ancient and Medieval Rhetoric and Poetic (3) Rhetorical and poetic doctrine of ancient and medieval times. *Professor Krauss*

Engl. 507. Research Problems in English (1-6) The methods of research in English, the problems of bibliography, and the method of evaluating sources and materials.

Engl. 508. Beowulf (3) A reading of the text and a study of the prominent literary problems and relationships. Prerequisite: Engl. Lit. 31. *Professor Mead*

Engl. 509. Nondramatic Writers of the Elizabethan Period: the Prose Writers (3) *Professor Mead*

Engl. 510. Nondramatic Writers of the Elizabethan Period: the Poets (3) *Professor Locklin*

ENGL. 511. ELIZABETHAN DRAMA (3) *Professor Harris*

ENGL. 514. SHAKESPEARE (3) Special problems in the works of Shakespeare. *Professor Bowman*

ENGL. 515. THE AGE OF SWIFT (3) Special studies varying from year to year. *Professor Harris*

ENGL. 516. THE AGE OF JOHNSON (3) The work of Johnson and his circle. *Professor Mead*

ENGL. 517. BYRON, SHELLEY, AND KEATS (3) *Professor Ridenour*

ENGL. 518. PRE-ROMANTIC WRITERS (3) Development of Romantic ideas in the 18th century. *Professor Ridenour*

ENGL. 519. WORDSWORTH, COLERIDGE, SOUTHEY, AND SCOTT (3) *Professor Ridenour*

ENGL. 530. HISTORY OF THE ENGLISH LANGUAGE (3) Germanic background of English, phonological and morphological developments, dialect differentiations, and principles of linguistic change. *Professor Mead*

ENGL. 531. OLD ENGLISH (3) Old English language and literature with lectures on Old English and Germanic philology. *Professor Mead*

ENGL. 532. MIDDLE ENGLISH (3) Middle English language and literature with lectures on the development of Old English through Middle English to modern times. *Professor Mead*

ENGL. 533. LITERARY CRITICISM (3) An historical survey of the principles of literary criticism.

ENGL. 534. HISTORICAL ENGLISH GRAMMAR (3) The evolution of the grammatical system of English. *Professor Peck*

ENGL. 535. RENAISSANCE AND MODERN RHETORIC (3) The rhetorical and poetic doctrine of Renaissance and modern times. *Professor Rubin*

ENGL. 540. CHAUCER (3) Analysis of Chaucer's poetry in the light of its background, sources, and subsequent influences. *Professor Mead*

ENGL. 542. PROSE STYLE (3) The development of English prose style from the Elizabethan age to Dryden. *Professor Major*

ENGL. 543. CAVALIER AND ANGLICAN (3) The poetry and prose of the middle years of the 17th century from the death of Shakespeare to 1660. *Professor Mead*

ENGL. 544. RESTORATION LITERATURE (3) Selected studies of the writers in England between 1650 and 1700. *Professor Harris*

ENGL. 545. POETS OF THE VICTORIAN PERIOD, EXCLUSIVE OF TENNYSON AND BROWNING (3) *Professor Long*

ENGL. 546. TENNYSON AND BROWNING (3) *Professor Long*

ENGL. 547. PROSE WRITERS OF THE VICTORIAN PERIOD (3) *Professor Long*

ENGL. 550. SELECTED STUDIES IN THE BRITISH NOVEL TO 1840 (3) *Professor Bowman*

ENGL. 551. SELECTED STUDIES IN THE BRITISH NOVEL FROM 1840 TO THE PRESENT (3) *Professor Sutherland*

ENGL. 553. MODERN PROSE STYLE (3) English prose style from 1700 to the present. Continuation of Engl. 542. *Professor Major*

ENGL. 554. RHETORICAL TECHNIQUES (3) Studies in the techniques of special types of writing, such as humor, satire, and propaganda. Prerequisites: 12 credits in English or American literature and 12 in English composition. *Professor Graves*

ENGL. 562. HISTORY OF THE AMERICAN NOVEL (3) *Professor Werner*

ENGL. 563. AMERICAN ESSAYS (3) Lectures and reports on a special group of essayists. *Professor Werner*

ENGL. 565. THE AMERICAN SHORT STORY (3) *Professor Werner*

ENGL. 566. HISTORY OF AMERICAN POETRY (3) *Professor Werner*

ENGL. 567. ANGLO-AMERICAN FOLK SONG (3) Oral tradition of melodies and texts; types, regions, theories. *Professor Bayard*

ENGL. 580. PRE-SHAKESPEAREAN DRAMA (3) *Professor Harris*

ENGL. 599. THESIS (1-15 per semester)

ENGLISH COMPOSITION

PROFESSOR THEODORE J. GATES, M.A.
Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

ENGL. COMP. 404. PUBLIC OPINION AND WRITTEN PERSUASION (3) *Professor Graves*

ENGL. COMP. 418. THE WRITING OF LITERARY CRITICISM (3) *Professor Rubin*

ENGLISH LITERATURE

PROFESSOR BRICE HARRIS, M.A., Ph.D.
Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

ENGL. LIT. 400. TEACHERS' COURSE IN LITERATURE (3) *Professor Merrill*

ENGL. LIT. 401. MAIN CURRENTS IN AMERICAN LITERATURE (3) *Professor Merrill*

ENGL. LIT. 423. FORMS AND MOVEMENTS OF BRITISH LITERATURE (3) *Professor Ridenour*

ENGL. LIT. 439a,b,cS. OUR CONTEMPORARIES (3)

ENGL. LIT. 440a,b,cS. MASTERS OF LITERATURE (1-3)

ENGL. LIT. 441a,b,cS. MASTERS OF ENGLISH LITERATURE (1-3)

ENGL. LIT. 460. LITERARY BIOGRAPHY (3) *Professor Merrill*

ENGL. LIT. 464. SPENSER (3) *Professor Locklin*

ENGL. LIT. 466. MILTON (3) *Professor Harris*

ENGL. LIT. 475a,b,cS. WORLD LITERATURE IN ENGLISH (3-9)

ENGL. LIT. 484. AMERICAN DRAMA (3) *Professor Cloetingh*

ENGL. LIT. 485. SCANDINAVIAN DRAMA (3) *Professor Cloetingh*

ENGL. LIT. 486. LATER BRITISH AND IRISH DRAMATISTS (3) *Professor Cloetingh*

ENGL. LIT. 487. MODERN CONTINENTAL DRAMA (3) *Professor Cloetingh*

ENGL. LIT. 489a,b,cS. COMPOSITE COURSE IN DRAMA (3-9)

ENGL. LIT. 489dS. CONTEMPORARY DRAMA (3)

ENTOMOLOGY

PROFESSOR PENNOYER F. ENGLISH, M.S., Ph.D.
Acting Head of the Department of Zoology and Entomology

ENT. 505. ADVANCED MORPHOLOGY OF INSECTS (3) Advanced work in either the external or internal morphology of insects. Prerequisites: Ent. 403, 405. *Professor Rutschky*

ENT. 508. THE BIOLOGICAL CONTROL OF INSECTS (2) The artificial use of bacteria, fungous diseases, and animals in the control of injurious insects; methods and equipment for rearing parasites and predators on a large scale. Prerequisites: Ent. 6, 8, 407. *Professor Frost*

ENT. 509. ENTOMOLOGICAL TECHNIQUE (2) For advanced students dealing with special methods of collecting, rearing living insects, preparing and preserving immature stages, keeping records, and preparing illustrations for manuscript. Prerequisite: Ent. 6. *Professor Frost*

ENT. 513. ENTOMOLOGICAL RESEARCH (1-15 per semester) Prerequisites: Ent. 405, 407.

ENT. 514. ADVANCED SYSTEMATIC ENTOMOLOGY (1-15 per semester) Taxonomy of the various orders of insects selected to meet the needs of the individual student. Prerequisites: Ent. 403, 405. *Professor Rutschky*

ENT. 528. INSECT PHYSIOLOGY (3) The normal functions of the insect body. Prerequisites: Ent. 405, Zool. 41. *Professor Dills*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ENT. 401. MEDICAL AND VETERINARY ENTOMOLOGY (3) *Professor Frings*

ENT. 403. SYSTEMATIC ENTOMOLOGY (3) *Professor Rutschky*

ENT. 405. INSECT MORPHOLOGY (3) *Professor Rutschky*
ENT. 407. INSECT ECOLOGY (3) *Professor Frost*
ENT. 413. ENTOMOLOGY SEMINAR (1 per semester) *Professor Frost*
ENT. 429. PRINCIPLES OF INSECT CONTROL (2) *Professor Frost*
ENT. 430. INSECT HISTOLOGY (2) *Professor Rutschky*
ENT. 431. ENTOMOLOGICAL PROBLEMS (1-6)

FAMILY ECONOMICS AND HOME MANAGEMENT

PROFESSOR DELPHA E. WIESENDANGER, M.S.
Acting Head of the Department of Home Management, Housing, and Art

H. MGMT. 500. RESEARCH IN FAMILY ECONOMICS OR HOME MANAGEMENT (1-6 per semester)

H. MGMT. 501. THESIS (1-15)

H. MGMT. 515, 515X. CONSUMER PROBLEMS (2-3) Methods of securing, evaluating, and presenting data concerning household commodities. For home economics teachers in high schools, colleges, and adult classes. Prerequisites: Fd. Ntr. 220, H. Mgmt. 442. *Professor Honey*

H. MGMT. 524. ECONOMIC PROBLEMS OF THE HOUSEHOLD (3) Economic problems of the present-day family; special emphasis on factors in household production, use of money income, and standards of living. Prerequisites: H. Mgmt. 439, Econ. 14. *Professor Honey*

H. MGMT. 528. HOME MANAGEMENT SUPERVISION (2-3) Evaluation of objectives and techniques in the organization, supervision, and teaching of the home management house experience. Prerequisite: H. Mgmt. 439.

H. MGMT. 543. HOME MANAGEMENT IN RELATION TO FAMILY LIVING (3) Includes work with families in solution of their management problems. Prerequisites: Fd. Ntr. 220, H. Mgmt. 439. *Professor Wiesendanger*

H. MGMT. 544. SPECIAL PROBLEMS IN HOUSE MANAGEMENT (3) Specific management problems, such as social, financial, and material, including the development of college level teaching aids. Prerequisite: 6 credits of home management or family economics courses in home economics. *Professor Wiesendanger*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

H. MGMT. 415. HOUSEHOLD BUYING PRACTICES (3)
H. MGMT. 419. MANAGING FAMILY FINANCIAL RESOURCES (3)
H. MGMT. 424. ECONOMIC CONDITIONS IN RELATION TO THE FAMILY (3)
H. MGMT. 439, 439X. HOME MANAGEMENT (2) *Professor Starr*
H. MGMT. 442. RESIDENT EXPERIENCE IN HOME MANAGEMENT (3) Room and board will be charged at regular rates. *Professor Starr*
H. MGMT. 445. HOME MANAGEMENT EXPERIENCE (3) *Professor Starr*
H. MGMT. 477. FAMILY MANAGEMENT (3)

FOODS, NUTRITION, AND HEALTH

Professor Eva D. Wilson, Ph.D.
Head of the Department

Fd. Ntr. 500. Research in Foods and Nutrition (1-6 per semester)

Fd. Ntr. 501. Thesis (1-15)

Fd. Ntr. 520. Readings in Foods (3) Readings and discussion of selected food problems.

Fd. Ntr. 521. Seminar in Foods (1-6) Discussion and reports on current research in the foods field. Prerequisite or concurrent: Fd. Ntr. 520.

Fd. Ntr. 522. Individual Food Problems (2-6) Intensive study of specific problems in food preparation. Prerequisite: Fd. Ntr. 420.

Fd. Ntr. 523. Economic and Nutritional Phases of Menu Planning (2-4) Food expenditures in relation to nutritional value and income. Prerequisites: Fd. Ntr. 450, Econ. 14.

Fd. Ntr. 550. Readings in Nutrition (3) Readings and reports of selected topics in nutrition. Prerequisite: Fd. Ntr. 450.

Fd. Ntr. 551. Nutrition Seminar (3-6) Selected topics and recent advances in nutrition. Prerequisite: Fd. Ntr. 450.

Fd. Ntr. 552. Diet in Diseases (3) Reports and discussions of the problems of adaptation of diet to disorders of nutrition. Prerequisite: Fd. Ntr. 450.

Fd. Ntr. 553. Nutrition of Children (3) The nutritional needs of the normal child during prenatal life, infancy, and childhood. Prerequisites: Agr. Biochem. 35, Fd. Ntr. 450.

Fd. Ntr. 554. Techniques in Human Nutrition Research (3) The more usual techniques employed by the research worker in human nutrition, accompanied by directed experience in their use and interpretation. Prerequisite or concurrent: Fd. Ntr. 551.

Fd. Ntr. 555. Field Work in Nutrition (2-4) Field problems planned to meet needs of individual students. Prerequisite: Fd. Ntr. 450. Hours and problems to be arranged.

Fd. Ntr. 556. The Survey Method in Foods and Nutrition (2) A study of survey technique as a tool in the assay of food adequacy and nutritional status.
Professor Dodds

Fd. Ntr. 557. Interrelationships of Nutrients (2) Interrelationships of nutrients in metabolic processes, their significance as applied to nutrition and in terms of the contribution of food stuffs. Prerequisites: Fd. Ntr. 450, Agr. Biochem. 437.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fd. Ntr. 420. Experimental Cookery (1-6) *Professor Olson*
Fd. Ntr. 421. Advanced Foods (3) *Professor Levcowich*
Fd. Ntr. 425. Food Preservation (1-2)
Fd. Ntr. 426. Recent Developments in Foods (3)
Fd. Ntr. 450. Nutrition (4) *Professors Padgett and Pike*
Fd. Ntr. 451. Family Nutrition (3) *Professor Padgett*
Fd. Ntr. 452. Elements of Diet in Disease (3) *Professor Pike*
Fd. Ntr. 453. Diet Therapy (3) *Professor Padgett*
Fd. Ntr. 455. Teaching Nutrition to Boys and Girls (3)
Fd. Ntr. 491, 491v. Teaching Home Nursing (1)

FORESTRY

Professor Victor A. Beede, M.F.
Head of the Department

For. 500. National and State Administration (3-5) Comparison of the policy and administration of the national forests with the forests of other countries and of the different states. *Professor Beede*

For. 502. Wood Fibers (3-5) Identification and physical and chemical characteristics of wood fibers used for pulp, either for paper or as a source of cellulose. Pulping quality, fiber measurements. *Professor White*

For. 504. Research Methods in Forestry (2-6 per semester) Review of methods employed in conducting forestry research. *Professor Bramble*

For. 508. Forest Ecology (2-4) The organization, development, and classification of forest communities. *Professor Bramble*

For. 509. Covert Management (2) Management of forest associations for maintenance and development of wildlife. Prerequisite: For. 508. *Professor Bramble*

For. 510. Seminar (1-2 per semester) Current problems of forest research presented as weekly seminar reports. May be repeated with additional credit for each semester's work. *Professor Bramble*

For. 530. Research in Wood Utilization (3-6 per semester) Research in some phase of wood utilization of forest products. Prerequisite: For. 431. *Professor Norton*

For. 531. Structural Uses of Wood and Wood Products (3-6 per semester) Wood as a construction material; testing techniques for structural timbers and wood assemblies; use of laminated wood, ring connectors, and other types of special construction. Prerequisite: For. 404. *Professor Norton*

For. 532. Laminates (3-6 per semester) Advanced and special studies in the fabrication and use of plywood, laminated wood, paper-base laminates, and wood-to-metal bonding. Prerequisite: For. 405. *Professor Norton*

For. 535. Conditioning Treatments for Wood (3-6 per semester) Advanced study and problems in preservative, seasoning, and other special treatments for wood and wood products. Prerequisite: For. 435. *Professor Norton*

For. 550. Forest Mensuration (2-8 per semester) Research in some chosen field. Prerequisite: For. 450. *Professor Meyer*

For. 560. Forest Management (3-8) Special topics in forest management and research in some chosen field. Prerequisite: For. 466. *Professor Meyer*

For. 575. Applications of Forest Economics and Finance (3 per semester) Survey of situations in forestry where business problems and particular circumstances of production, value, and costs are currently significant. Prerequisite: For. 70. *Professor Humphrey*

For. 590. The Lumber Industry (2-4) The relation of the lumber industry to national economy and world trade; lumberman's associations; lumber accounts. Prerequisite: For. 430.

For. 591. Problems in Lumbering (2-6) Research in some chosen phase of lumbering. Prerequisite or concurrent: For. 590.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

For. 400.	Advanced Silviculture (2)	*Professor Bramble*
For. 402.	Forest Research (2)	*Professor Bramble*
For. 404.	Mechanical Properties of Wood (3)	*Professor Norton*
For. 405.	Veneer and Plywood (3)	*Professor Norton*
For. 406.	Forestry Literature (1)	*Professor White*
For. 417.	National and State Forest Practice (2)	*Professor Beede*
For. 421.	Regional Silviculture (4)	*Professor Cope*
For. 427.	Forest Uses (3)	*Professor Bramble*
For. 430.	Forest Products and Industries (3)	*Professor Norton*
For. 431.	Advanced Utilization (2-4)	*Professor Norton*
For. 435.	Seasoning and Preservation (3)	*Professor Norton*
For. 445.	Improvements (3)	
For. 446.	Forest Park Administration (3)	
For. 450.	Advanced Mensuration (2)	*Professor Meyer*
For. 451.	Statistics in Forestry and Wood Utilization (3)	*Professor Meyer*
For. 455.	Aerial Photogrammetry in Forest Management (2)	
For. 462.	Advanced Wood Technology (2)	*Professor White*
For. 466.	Forest Management and Management Plans (4)	*Professor Meyer*
For. 468.	Silvicultural Research (2-4)	*Professor Bramble*
For. 469.	Problems in Forest Management (3)	*Professor Meyer*
For. 475.	Problems in Forest Economics and Finance (3)	*Professor Humphrey*
For. 480.	Policy and Administration (3)	*Professor Beede*
For. 491.	Lumbering (3)	
For. 492.	Lumber Distribution (3)	

For. 494. Logging (3)
For. 495. Milling (3)
For. 497. Small Sawmills (3)

FRENCH

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

ACADEMIC YEAR

Fr. 544. Neoclassicism in the Romance Literatures (3) The nature and development of the Neoclassic movement in Italy, France, Spain, and Portugal. Prerequisite: Fr. 40.

Fr. 545. Romanticism in the Romance Literatures (3) The nature and development of the Romantic movement in Italy, France, Spain, and Portugal.

Fr. 546. Medieval Romance Literatures (3) The nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal.

Fr. 547. Realism, with Particular Reference to Romance Literatures (3)

Fr. 548. 20th Century Romance Literature as a Political Force (3)

Fr. 551. Romance Philology (3) Historical development of the Romance languages.

Fr. 552. Old and Middle French Readings and Literature (3) Familiarizes the student with Old and Middle French texts from the earliest monument to Villon. Prerequisite: Fr. 551.

Fr. 553. French Literature of the Renaissance (3) The French Renaissance from 1498 to 1548.

Fr. 554. The Renaissance in the Romance Literatures (3) Themes and forms of literature in the humanistic period.

Fr. 557. French Romantic Poetry (3)

Fr. 562. French Thinkers of the 18th Century (3)

Fr. 564. French Romanticism (3) The French Romantic Movement after 1830.

Fr. 570. Voltaire and Rousseau (3)

Fr. 571. Seminar in French Literature (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

Fr. 572. Seminar in French Literature (3) Continuation of Fr. 571.

Fr. 574. Methods and Bibliography in Romance Languages and Literatures (1-2)

Fr. 580. Proust and Gide (3)

Fr. 599. Dissertation (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fr. 400. French Literature of the 16th Century (3)
Fr. 401. French Theater of the Classical Period (3)
Fr. 403. French Dramatic Literature of the 18th Century (3)
Fr. 405. French Literature of the 19th Century (3)
Fr. 406. French Literature of the 19th Century (3)
Fr. 407. French Novel of the 19th Century (3)
Fr. 410. French Poetry of the 19th Century (3)
Fr. 411. French Literature of the 20th Century (3)
Fr. 413, 413X. Contemporary French Drama (3)
Fr. 415. French Novel of the 18th Century (3)
Fr. 421. The Teaching of Romance Languages (3)
Fr. 471. Problems in French Literature (3-6)
Fr. 490. Advanced Composition and Conversation (3)
Fr. 496. Literary Criticism in France, Italy, and Spain (3)

MAIN SUMMER SESSION

Fr. 505S. The Great Writers of France (2)
Fr. 507S. La Fontaine and His Time (2)
Fr. 528S. French Lyric Poetry of the 19th Century (2)
Fr. 531S. French Novelists of the Romantic School (2)
Fr. 538S. The Romantic Poets (2)
Fr. 540S. Contemporary French Drama (2)
Fr. 541S. Modern French Drama (2)
Fr. 542S. The French Short Story of the 19th Century (2)
Fr. 555S. Victor Hugo and His Time (2)
Fr. 556S. Charles Baudelaire (2)
Fr. 557S. French Romantic Poetry (2)
Fr. 559S. France Between Two Wars (2)
Fr. 560S. Molière and the Classical Comedy (2)
Fr. 565S. French Literature of the 19th Century (2)
Fr. 566S. Classical French Literature (2)
Fr. 567S. The French Novel from 1870 to 1914 (2)
Fr. 568S. The Contemporary Novel (2)
Fr. 570S. Voltaire and Rousseau (2)
Fr. 575S. Advanced Phonetics (2)
Fr. 576S. Composition and Stylistics (2)
Fr. 577S. Advanced Composition and Stylistics (3-6)

Fr. 579S. Research Laboratory and Phonetics (1)
Fr. 587S. French Novelists of the 18th Century (2)
Fr. 588S. French Poetry: from Baudelaire to the Symbolists (2)
Fr. 591S. French in the Secondary Schools (3)
Fr. 592S. French and Spanish in the Secondary Schools (3)
Fr. 599S. Dissertation (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fr. 409S. Advanced Course in Pronunciation and Conversation (2)
Fr. 469S. French Civilization of the 19th Century (2)
Fr. 493S. Elementary Phonetics (2)
Fr. 495S. Advanced Composition and Syntax (3)
Fr. 498S. Intermediate Phonetics (2)

FUEL TECHNOLOGY

Professor C. C. Wright, Ph.D.
Chief of the Division

Fuel T. 502. Research Data (3) Designed for the graduate student beginning laboratory research; methods of obtaining and interpreting research data. Prerequisite: Math. 30. *Professor Nielsen*

Fuel T. 503. Chemical Constitution and Scientific Classification of Coal (3-6) The chemistry of plant constituents in relation to coal and the coalification process; constitution of coal as deduced by chemical methods; scientific classification of coals. Prerequisite: Chem. 31. *Professor Kinney*

Fuel T. 504. Fuel Technology Research (1-15 per semester) Original research on preparation, carbonization, processing, utilization, or constitution of fuels. Results of the investigation may be used as the thesis. Prerequisites: Fuel T. 502, 503. *Professor Wright and Staff*

Fuel T. 505. Physicochemical Properties of Coal, Mineral Matter, and Ash (3) Physical, physicochemical, and use properties; their significance and applications. Prerequisite: Chem. 41.

Fuel T. 506. Advanced Combustion (3) Advanced combustion and heat balance calculations, ignition and flame characteristics of fuels; furnace atmospheres; selection of fuels with reference to use and equipment. Prerequisite: Chem. 41. *Professor Wright*

Fuel T. 507. Advanced Thermal Processing (3) Pyrolysis, coal carbonization, coke manufacture and uses; action of heat on coals and fuels; technical and economic factors. Prerequisites: Chem. 35, 41, or Min. Prep. 410.

Fuel T. 508. Synthesis of Liquid Fuels (3) Chemical nature of liquid hydrocarbons; preparation of hydrogen and synthesis gas; theoretical and practical aspects

of synthetic liquid fuel processes. Prerequisites: Chem. 31, Fuel T. 402.
Professor Kinney

Fuel T. 509. Technology of Tars (3) Formation, constitution, physical and chemical properties of coal, oil-gas and water-gas tar; processing and utilization. Prerequisite: Chem. 31. *Professor Polansky*

Fuel T. 510. Fuel Technology Problem (1-6 per semester) Special problems in fuel technology. Prerequisite: Fuel T. 503. *Professor Wright and Staff*

Fuel T. 511. Fuel Technology Seminar (1-6) Selected topics from current fuel technology research examined and discussed. Prerequisite: Chem. 35 or 41.
Professor Wright and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Fuel T. 400. Fuel Technology Research and Design (1-3)
Professor Wright and Staff
Fuel T. 401. Fuel Gases and Gasification (3) *Professor Wright*
Fuel T. 402. Chemical Processing of Fuels (2) *Professor Kinney*
Fuel T. 403. Energetics of Fuel Technology (3) *Professor Gauger*
Fuel T. 404. Fuel Technology Design (3) *Professor Spicer*

GENERAL HOME ECONOMICS

Professor Helen R. LeBaron, M.S., Ph.D.
Assistant Dean of the School of Home Economics

Gen. H.E. 500. Research in General Home Economics (1-6 per semester)

Gen. H.E. 501. Thesis (1-15)

Gen. H.E. 516, 516v. Methods of Research in Home Economics (3) Review of problems and techniques of research in home economics. Required of all graduate students in home economics. *Professor Hatcher*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Gen. H.E. 400, 400v, 400X, 400vX. Recent Findings in Home Economics (2-3)

GEOGRAPHY

Professor E. Willard Miller, M.A., Ph.D.
Chief of the Division

Geog. 503. Advanced Regional Geography (3-12) Intensive study at an advanced level of selected regions or sections of the continents. Prerequisite: 12 credits in geography. *Professors Miller and Deasy*

GEOG. 504. PHYSICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of physical geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professors Miller and Deasy*

GEOG. 505. ECONOMIC GEOGRAPHY SEMINAR (3-12) The literature of some phase of economic geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor Miller*

GEOG. 506. CULTURAL AND POLITICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of cultural and political geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor Griess*

GEOG. 510. PHYSICAL GEOGRAPHY RESEARCH (3-10) Original study in physical geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Deasy*

GEOG. 511. ECONOMIC GEOGRAPHY RESEARCH (3-10) Original study in economic geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Miller*

GEOG. 512. CULTURAL AND POLITICAL GEOGRAPHY RESEARCH (3-10) Original study in cultural and political geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Griess*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GEOG. 400.	REGIONAL GEOGRAPHY OF NORTH AMERICA (3)	*Professor Deasy*
GEOG. 401.	REGIONAL GEOGRAPHY OF PENNSYLVANIA (3)	*Professor Miller*
GEOG. 403.	REGIONAL GEOGRAPHY OF SOUTH AMERICA (3)	*Professor Griess*
GEOG. 405.	CULTURAL GEOGRAPHY (3)	*Professor Griess*
GEOG. 433.	REGIONAL CLIMATOLOGY (3)	*Professor Deasy*
GEOG. 435.	FIELD METHODS IN GEOGRAPHY (3)	*Professor Miller*
GEOG. 442.	GEOGRAPHY OF EUROPE (3)	*Professor Miller*
GEOG. 443.	GEOGRAPHY OF THE ORIENT (3)	*Professor Rodgers*
GEOG. 444.	GEOGRAPHY OF AFRICA (3)	*Professor Griess*
GEOG. 445.	GEOGRAPHY OF THE AIR AGE (3)	*Professor Miller*
GEOG. 452.	INTERPRETATION OF AERIAL PHOTOGRAPHS (3)	*Professor Deasy*
GEOG. 460.	POLITICAL GEOGRAPHY (3)	*Professor Griess*
GEOG. 480.	GEOGRAPHY OF WORLD MANUFACTURING (3)	*Professor Miller*

GEOLOGY

PROFESSOR FRANK M. SWARTZ, Ph.D.
Chief of the Division

*GEOL. 500. GEOLOGY SEMINAR (1-9) Presentation, at weekly departmental meetings, of topics selected from geological literature.

* Credits to be arranged, 1 to 6 per semester.

†GEOL. 501. STRATIGRAPHY (3-12) Principles of stratigraphic classification, lithofacies and biofacies, faunal zonation, correlation, sedimentation, and paleogeography, illustrated by stratigraphy of classical geologic regions: (a) Pre-Cambrian; (b) Paleozoic; (c) Mesozoic; (d) Cenozoic. Prerequisite: Geol. 464. *Professor Swartz*

GEOL. 502. GEOLOGICAL RESEARCH (3-18) An original investigation of a geological problem approved by the chief of the division. Results of the investigation may be used for the thesis.

†GEOL. 503. PALEONTOLOGY (3-9) Morphology of animal groups significant for their fossils; nature of species and faunal zones. Seminars may be arranged for studies of special fossil groups, microfossils, paleoecology. *Professor Swartz*

GEOL. 504. HISTORY OF GEOLOGY (2-3) Development through the ages of the scientific method in the earth sciences. *Professor Krynine*

GEOL. 507. SEMINAR IN GEOMORPHOLOGY (3-6) Classic and current literature in geomorphology. *Professor Miller*

GEOL. 508. PRINCIPLES OF GEOMORPHOLOGY (3-6) Physical and chemical processes that have formed the present landscape. *Professor Miller*

GEOL. 511. ORE DEPOSITS: PRINCIPLES (3-6) Geological and geochemical processes controlling ore deposition; genetic classification of ore deposits. Prerequisite: Geol. 451. *Professor Ridge*

GEOL. 512. ORE DEPOSITS: TYPES (3-6) Geologic history of selected ore bodies with respect to forming media; causes, sequences, and loci of emplacement; wall rock alteration and secondary enrichment. Prerequisite: Geol. 511. *Professor Ridge*

GEOL. 513. ORE DEPOSITS: CHEMICAL PROSPECTING (3-6) Methods of prospecting using techniques of geochemical, biochemical, and hydrochemical analysis. Prerequisites: Chem. 20, Geol. 451. *Professor Ridge*

GEOL. 514. ORE DEPOSITS: FIELD STUDY (1-2) Field study of ore deposits in eastern Pennsylvania, northern New Jersey, the Adirondacks, and eastern Ontario. Prerequisite: Geol. 512. *Professor Ridge*

GEOL. 515. ORE MICROSCOPY (2-3) Theory and use of the ore microscope in identifying ore minerals in polished section, establishing paragenetic sequences, determining manner of deposition. Prerequisite: Geol. 513. *Professor Ridge*

GEOL. 520. PALEOBOTANY (3-6) Classification, morphology, nomenclature, and stratigraphic occurrence of fossil plants. Prerequisite: Geol. 32. *Professor Spackman*

GEOL. 524. GEOLOGY OF COAL (1-6) Origin, geologic modifications, microscopy of coal; relations to enclosing sediments; geologic and geographic distribution. Prerequisite: Geol. 32 or Chem. 35. *Professor Spackman*

† Credits to be arranged, 3 to 6 per semester.

GEOL. 530. GEOLOGICAL PROBLEMS (3-6) Study, from the literature, of a selected geological problem. Prerequisite: 10 credits of geology and mineralogy.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GEOL. 451. ECONOMIC GEOLOGY (3)
GEOL. 461. GEOLOGY OF THE UNITED STATES (3) *Professor Miller*
GEOL. 464. PALEONTOLOGY (3) *Professor Swartz*
GEOL. 481. GEOLOGY OF OIL AND GAS (3)
GEOL. 482. METALLIC MINERAL DEPOSITS (3)
GEOL. 483. STRUCTURAL GEOLOGY (3) *Professor Osberg*
GEOL. 484. PALEOZOIC STRATIGRAPHY (3) *Professor Swartz*
GEOL. 485. PALEONTOLOGY (2) *Professor Swartz*
GEOL. 486. STRATIGRAPHIC METHODS (1) *Professor Swartz*
GEOL. 488. EARTH SCIENCES SEMINAR (1)
GEOL. 489. EARTH SCIENCES REPORT (1)

GEOPHYSICS AND GEOCHEMISTRY

PROFESSOR B. F. HOWELL, JR., M.S., Ph.D.
Chief of the Division

GEOPHYS. 500. GEOPHYSICAL SEMINAR (1 per semester) Discussion of geophysical reports and papers; scientific outlook. Prerequisites: Geophys. 401, 402.
Professor Howell

GEOPHYS. 501. RESEARCH (1-15 per semester) Original research in geophysics or geochemistry.

GEOPHYS. 502. SEISMIC INSTRUMENTS (2) Characteristics and design of seismometers and seismic recorders. Given alternate years. Prerequisites: Phys. 285, differential equations. *Professor Howell*

GEOPHYS. 503. SPECIAL STUDIES IN GEOPHYSICS (1-9) Special studies of the theories of geophysical methods. Prerequisite: 6 credits in geophysics.
Professor Howell

GEOPHYS. 507. SEISMOLOGY (3) Nature and transmission of seismic waves; cause and occurrence of earthquakes; applications in seismic prospecting. Prerequisites: Math. 431, Phys. 285. *Professor Howell*

GEOPHYS. 508. TECTONICS (3) Seminar in the cause and nature of the principal deformations of the earth. Prerequisite: Geol. 483. *Professor Howell*

GEOPHYS. 509. GEOCHEMISTRY SEMINAR (1 per semester) Prerequisite: Geophys. 406. *Professor Keith*

GEOPHYS. 510. PROBLEMS IN GEOCHEMISTRY (1-9) Laboratory and library study of special problems. Prerequisite: Geophys. 406.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GEOPHYS. 401. MINING GEOPHYSICS (3)
GEOPHYS. 402. PETROLEUM GEOPHYSICAL PROSPECTING (3) *Professor Howell*
GEOPHYS. 403. GEOPHYSICS FIELD WORK (1-3) Summer practicum.
GEOPHYS. 404. MINING GEOPHYSICS LABORATORY (1)
GEOPHYS. 405. INTRODUCTORY GEOPHYSICS (3) *Professor Howell*
GEOPHYS. 406. INTRODUCTORY GEOCHEMISTRY (3) *Professor Keith*
GEOPHYS. 407. WELL LOGGING (2)

GERMAN

PROFESSOR PHILIP A. SHELLEY, A.M., Ph.D.
Head of the Department

GER. 501. GERMAN LANGUAGE SEMINAR (3-9) Critical study of special problems in the Germanic languages, with emphasis on Gothic and the High German dialects in different eras. Papers.

GER. 515. GERMAN LITERATURE SEMINAR (3-9) Special aspects and characteristics of individual writers and various types and periods of literature.

GER. 524. INTENSIVE STUDY OF THE LIFE AND WORKS OF GOETHE (3) Various phases of the poet's life and individual works. *Professor Buffington*

GER. 531. SPECIAL STUDIES IN THE GERMAN LYRIC (3) *Professor Shelley*

GER. 532. SPECIAL STUDIES IN THE GERMAN DRAMA (3) *Professor Adolf*

GER. 533. SPECIAL STUDIES IN THE GERMAN SHORT STORY (3) *Professor Steiner*

GER. 534. SPECIAL STUDIES IN THE GERMAN NOVEL (3) *Professor Adolf*

GER. 551. MIDDLE HIGH GERMAN (3) Extensive reading of texts; characteristics of the various dialects. *Professor Buffington*

GER. 552. OLD HIGH GERMAN (3) Essentials of the grammar, with special treatment of the High German sound shift and of ablaut and umlaut. Reading of works written before 1100 A. D. Papers. *Professor Buffington*

GER. 553. GOTHIC (3) Essentials of the grammar; reading of Ulfilas' Bible translation. Suitable also for advanced students in English. Papers. *Professor Adolf*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

GER. 400. PROSEMINAR IN BIBLIOGRAPHY AND METHODS OF RESEARCH (2) *Professor Shelley*

GER. 401. HISTORY OF THE GERMAN LANGUAGE (3) *Professor Buffington*
GER. 421. GERMAN LITERATURE IN THE 18TH CENTURY (3) *Professor Buffington*
GER. 422. GERMAN LITERATURE IN THE 19TH CENTURY (3) *Professor Adolf*
GER. 423. GERMAN LITERATURE OF THE 20TH CENTURY (3) *Professor Steiner*
GER. 443. LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3-9) *Professor Shelley*

GREEK

PROFESSOR ROBERT E. DENGLER, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

GREEK 500. GREEK COMPOSITION (2) Translation of extended narrative passages into Attic Greek; a thorough review of forms and syntax; attention to the rhetorical elements of the language. *Professor Dengler*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

GREEK 411S. ESSENTIALS OF GREEK (3)
GREEK 421. GREEK TRAGEDY (3) *Professor Dengler*
GREEK 422. GREEK COMEDY (3) *Professor Dengler*
GREEK 423. ATTIC ORATORS (3) *Professor Dengler*
GREEK 424. GREEK HISTORY OR PHILOSOPHY (3) *Professor Dengler*
GREEK 427. NEW TESTAMENT GREEK (3) *Professor Dengler*

HEALTH EDUCATION

Consult PROFESSOR ARTHUR L. HARNETT, JR., M.A., Ed.D.

HEALTH ED. 501. HEALTH IMPLICATIONS IN THE GROWTH AND DEVELOPMENT OF SCHOOL CHILDREN (3) Child growth and development emphasis for teachers; medical inspection and examination; preschool program; early habit formations; behavior problems; co-operation of parents, teachers, and children. Prerequisite: Health Ed. 215. *Professor Davis*

HEALTH ED. 505. ADVANCED TECHNIQUES IN HEALTH EDUCATION (3) Prerequisites: Health Ed. 215, 399, Psy. 437. *Professor Harnett*

HEALTH ED. 572. TESTS AND MEASUREMENTS IN HEALTH EDUCATION (3) Critical study, evaluation, and demonstration of tests and measures of health education; statistical computations of data. Prerequisites: Phys. Ed. 490, Health Ed. 215, 399. *Professor Masley*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HEALTH ED. 403. FIRST AID, ATHLETIC CONDITIONING AND TRAINING (3) *Professor Fogg*

HEALTH ED. 405. RECENT DEVELOPMENTS IN PUBLIC HEALTH EDUCATION (3-6) *Professor Davis*

HEALTH ED. 406. RECENT DEVELOPMENTS IN SCHOOL HEALTH EDUCATION (3) *Professor Davis*

HEALTH ED. 407, 407X. ADVANCED PERSONAL AND PUBLIC HEALTH (3) *Professor Harnett*

HEALTH ED. 411, 411X. SAFETY EDUCATION IN THE SCHOOLS (3) *Professor Davis*

HEALTH ED. 427. HEALTH FACTORS IN THE DEVELOPMENT OF THE ADOLESCENT (3) *Professor Davis*

HEALTH ED. 453, 453X. ORGANIZATION AND ADMINISTRATION OF HEALTH EDUCATION (3) *Professor Harnett*

HEALTH ED. 455S. RELATIONSHIPS OF HEALTH EDUCATION TO THE EXACT SCIENCES (3) *Professor Harnett*

HEALTH ED. 456. ADVANCED TECHNIQUES IN RURAL SCHOOL HEALTH (3) *Professor Davis*

HEALTH ED. 495S. FAMILY HEALTH AND HUMAN RELATIONS (3-9) *Professor Davis*

HISTORY

PROFESSOR ALFRED G. PUNDT, M.A., Ph.D.
Head of the Department

HIST. 500. SEMINAR IN AMERICAN HISTORY (3-6) Subject to be announced. *Professors Gray, Hermann, and Klein*

HIST. 501. EUROPEAN HISTORIOGRAPHY (3) *Professor Pundt*

HIST. 502. AMERICAN HISTORIOGRAPHY (3) *Professor Klein*

HIST. 506. THE DIPLOMATIC BACKGROUND OF THE WORLD WAR, 1871 to 1914 (3) Prerequisites: Hist. 18, 19.

HIST. 507. THE REFORM MOVEMENT IN MODERN ENGLAND, 1832 TO THE PRESENT (3) *Professor Pundt*

HIST. 508. STUDIES IN EUROPEAN HISTORY, 1600-1789 (3) *Professor Pundt*

HIST. 509. THE FRENCH REVOLUTION AND NAPOLEONIC ERA, 1789-1815 (3) Prerequisites: Hist. 18, 19. *Professor Pundt*

HIST. 511. SEMINAR IN EUROPEAN HISTORY (3-6) *Professors Forster and Pundt*

HIST. 512. STUDIES IN PENNSYLVANIA HISTORY (3-6) *Professor Klein*

HIST. 520. THE AMERICAN REVOLUTION, 1763-1783 (3) Prerequisites: Hist. 20, 21. *Professor Hermann*

HIST. 529. CULTURAL HISTORY OF THE EARLY MIDDLE AGES (3) *Professor Dahmus*

HIST. 532. STUDIES IN MEDIEVAL CIVILIZATION (3) *Professor Dahmus*

HIST. 533. STUDIES IN HISTORY OF THE UNITED STATES, 1829-1860 (3) *Professor Klein*

HIST. 534. THE CIVIL WAR AND RECONSTRUCTION, 1860-1877 (3) Prerequisites: Hist. 20, 21. *Professors Klein and Hermann*

HIST. 536. STUDIES IN THE HISTORY OF THE UNITED STATES, 1877-1900 (3)

HIST. 538. STUDIES IN THE HISTORY OF FOREIGN RELATIONS OF THE UNITED STATES, 1492 TO THE PRESENT (3)

HIST. 562. SEMINAR IN LATIN-AMERICAN HISTORY (3-6) Prerequisites: Hist. 22, 23. *Professor Gray*

HIST. 563. STUDIES IN THE HISTORY OF THE CARIBBEAN AREA (3) Prerequisites: Hist. 22, 23. *Professor Gray*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

HIST. 405, 405X. HISTORICAL BACKGROUND OF AMERICAN POLITICAL PARTIES, 1607-1900 (3) *Professor Rayback*

HIST. 406. HISTORY OF AMERICAN LABOR (3) *Professor Rayback*

HIST. 407. THE DIPLOMATIC HISTORY OF THE UNITED STATES (3) *Professor DeNovo*

HIST. 418. RENAISSANCE AND REFORMATION (3)

HIST. 419, 419X. RECENT EUROPEAN HISTORY (3) *Professor Forster*

HIST. 421, 421X. RECENT AMERICAN HISTORY (3)

HIST. 423. THE FORMATIVE PERIOD OF AMERICAN HISTORY (3) *Professor Klein*

HIST. 437. THE MIDDLE AGES FROM CONSTANTINE TO THE CRUSADES (3) *Professor Dahmus*

HIST. 438. THE MIDDLE AGES FROM THE CRUSADES TO THE RENAISSANCE (3) *Professor Dahmus*

HIST. 439. HISTORY OF ENGLAND TO 1689 (3) *Professor Dahmus*

HIST. 440. HISTORY OF GREAT BRITAIN SINCE 1689 (3) *Professor Forster*

HIST. 441. RECENT HISTORY OF GREAT BRITAIN (3) *Professor Forster*

HIST. 443. HISTORY OF MODERN RUSSIA (3)

HIST. 444. EASTERN EUROPE IN MODERN TIMES (3)

HIST. 446. THE DEVELOPMENT OF THE BRITISH EMPIRE (3)

HIST. 447. ECONOMIC DEVELOPMENT OF MODERN EUROPE SINCE 1750 (3) *Professor Pundt*

HIST. 448. SOCIAL AND CULTURAL HISTORY OF MODERN EUROPE (3)

HIST. 450. ECONOMIC DEVELOPMENT OF COLONIAL AMERICA, 1607-1783 (3) To alternate with Hist. 451. *Professor Hermann*

HIST. 451. SOCIAL AND CULTURAL HISTORY OF COLONIAL AMERICA, 1607-1783 (3) To alternate with Hist. 450. *Professor Hermann*

HIST. 452. SOCIAL AND CULTURAL HISTORY OF THE UNITED STATES SINCE 1783 (3) *Professor Brown*

HIST. 453. AMERICAN POLITICAL BIOGRAPHY (3) *Professor Hermann*

HIST. 454. THE ECONOMIC DEVELOPMENT OF THE UNITED STATES IN THE 19TH CENTURY (3) *Professor McNall*

HIST. 460. LATIN AMERICA AND THE UNITED STATES (3) *Professor Gray*

HIST. 461. SOCIAL AND CULTURAL HISTORY OF LATIN AMERICA (3) To alternate with Hist. 460. *Professor Gray*

HIST. 499X. FOREIGN STUDY IN HISTORY (2-6)

HOME ART

PROFESSOR CHRISTINE F. SALMON, B.Arch., M.Arch.
Acting Chairman of the Division

H. ART 500. RESEARCH IN HOME ART (1-6 per semester)

H. ART 501. THESIS (1-15)

H. ART 515. BACKGROUNDS OF THE HOME ARTS (3) Evaluation of useful objects in respect to their form, function, and time; selections for exhibition. Prerequisites: H. Art 216 or Art 54 or Art Ed. 6, and Art 74 or H. Art 240.

H. ART 541. ART IN THE ENVIRONMENT (3) Approach based upon human needs with consideration of materials in the light of their use in home living. Prerequisite: Art 76 or Art Ed. 5 or H. Art 440.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

H. ART 433, 433X. ADVANCED HOME CRAFTS (2-12)
H. ART 434. THE ART AND THE CRAFTS IN THE HOMEMAKING PROGRAM (3-6)
H. ART 440, 440X. HOME FURNISHING PROBLEMS (3)
H. ART 443. HOME ARTS IN THE ADULT PROGRAM (3)
H. ART 444, 444X. HOME FURNISHING TEACHING PROBLEMS (3)
H. ART 447, 447X. HOME FURNISHINGS FOR THE FAMILY (3)

HOME-COMMUNITY RELATIONSHIPS

PROFESSOR HELEN R. LEBARON, M.S., Ph.D.
Chairman of the Division

H.C. REL. 500. RESEARCH IN HOME-COMMUNITY RELATIONSHIPS (1-6 per semester)

H.C. Rel. 501. Thesis (1-15)

H.C. Rel. 502, 502v, 502X, 502vX. Home Economics and American Society (3) Family life education in relation to a democratic culture; emphasis upon the interrelatedness of socioeconomic problems and the American family.

H.C. Rel. 503. Graduate Seminar in Home Economics (1)
Professor Henderson

HOME ECONOMICS EDUCATION

Professor Jean D. Amberson, M.A., Ph.D.
Head of the Department

H.E. Ed. 500, 500v. Research in Home Economics Education (1-6)
Professor Amberson or Hatcher

H.E. Ed. 501, 501v. Thesis (1-15)

H.E. Ed. 502, 502v. Home Economics Instruction at the College Level (3) Teaching techniques suitable for college instruction in home economics; for prospective home economics college teachers not majoring in home economics education.

H.E. Ed. 503, 503v. Problems in Home Economics Teacher Education (3) Organization of college programs of teacher education; use of resources; records; field services; recruitment and selection of personnel. Prerequisite: at least two years of experience in teaching home economics.

H.E. Ed. 505, 505v, 505X, 505vX. Practicum in Teaching Home Economics in the Secondary School (3-6) Projects in home economics education which may be carried out in the school in which the teacher is regularly employed.
Professor Amberson

H.E. Ed. 506, 506v, 506X, 506vX. Current Developments in Education in Relation to Home Economics (3) Opportunity for home economists to study newer developments in education. Prerequisite: one year of teaching experience in home economics. *Professor Amberson*

H.E. Ed. 509, 509v, 509X, 509vX. Curriculum Workshop in Family Life Education (3) Laboratory course in problems of curriculum building; individual problems in this field; frequent individual and group conferences. Prerequisite: one year's experience in teaching home economics. *Professor Amberson or Hatcher*

H.E. Ed. 510, 510v, 510X, 510vX. The Supervision of Home Economics Teaching (2-6) For teachers of home economics desiring to qualify as city, county, or student teacher supervisors. Prerequisite: graduation from four-year teacher training curriculum and two years' teaching experience in home economics.
Professors Amberson, Hatcher, or Riegel

H.E. Ed. 518, 518v, 518X, 518vX. Evaluation in Family Life Education (3) Methods of evaluating progress toward goals in home economics education and the use of findings in program planning and revision. *Professor Hatcher*

H.E. Ed. 521, 521v, 521X, 521vX. Home Economics Education Seminar (2-3) Selected topics and recent developments in education for family living. Conferences and guidance relative to individual research problems.
Professor Amberson or Hatcher

H.E. Ed. 526, 526v, 526X, 526vX. The Community Program in Family Life Education (2-3) Ways of discovering community needs and resources; methods in developing the community program in family living; leadership education for the lay member of the community.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

H.E. Ed. 406, 406v, 406X, 406vX. Teaching Aids in Family Life Education (1-4) *Professor Riegel*
H.E. Ed. 427, 427v, 427X, 427vX. Family Life Education (3)
H.E. Ed. 443, 443v, 443X, 443vX. Adult Homemaking Education (3) *Professor Cook*
H.E. Ed. 463, 463v. Senior Seminar (1)
H.E. Ed. 466, 466v. Student Teaching (9)
H.E. Ed. 478, 478v, 478X, 478vX. Appraising Student Progress in Education for Family Living (3)
H.E. Ed. 479, 479v. Readings in Home Economics Education (1-4)

HORTICULTURE

Professor Warren B. Mack, M.S., Ph.D., Sc.D., A.N.A.
Head of the Department

Hort. 500. Ecology of Fruit Plants (3) The factors limiting the distribution and intensity of culture of fruit species and varieties and the effect of environmental factors on cultural practices.

Hort. 501. Pomology Research (2-12) Investigation of problems involving review of literature, field and laboratory research. Prerequisite or concurrent: Hort. 445. *Professor White*

Hort. 503. Experimental Plant Breeding (3-6) Problems based mainly on the research work of the department, with a review of experimental methods and literature. Prerequisite: Hort. 444. *Professor Larson*

Hort. 504. Vegetable Crop Research (2-9) Investigation of problems involving review of literature, field and laboratory research. Prerequisite: Hort. 420 or 424. *Professor Odland*

Hort. 505. Problems in Vegetable Production (2-6) Methods used in the more valuable contributions to vegetable production. Prerequisite: Hort. 420 or 424. *Professor Odland*

HORT. 506. NUTRITION OF HORTICULTURAL CROPS (2-4) Principles, applications, and interpretations of diagnostic methods for determining fertilizer requirements of horticultural crops. *Mr. Smith*

HORT. 507. PLANT BREEDING RESEARCH (3-6) A critical review of the breeding projects of the department, with original investigations. Prerequisite: Hort. 444. *Professor Larson*

HORT. 512. PRINCIPLES OF FRUIT AND VEGETABLE STORAGE (2-4) Principles involved in the maturation, storage, and senescence of fruits and vegetables, and their application. *Professor Mack*

HORT. 513. RESEARCH IN ORNAMENTAL HORTICULTURE (2-12) Review of research in ornamental horticulture, with original investigations. *Professor Meahl*

HORT. 514. PROPAGATION OF ORNAMENTAL AND FRUIT PLANTS (3) Factors affecting the asexual and sexual propagation of fruit and ornamental plants. *Professor Meahl*

HORT. 517. HORTICULTURE SEMINAR (1 per semester) Review of current research publications in horticulture. Each student presents one or more reviews of assigned topics.

HORT. 518. RESEARCH PROBLEMS IN LANDSCAPE HORTICULTURE (2-12) Selected problems to be assigned for original investigation in the creation, conservation, or management of planted areas. Prerequisite: Hort. 455. *Professor Bracken*

HORT. 519. SEMINAR ON THE GENETICS OF HORTICULTURAL CROPS (1 per semester) Review of current research publications on the genetics of horticultural crops. Each student presents one or more reviews of literature on assigned topics.

HORT. 520. SEMINAR ON THE BREEDING OF HORTICULTURAL CROPS (1 per semester) Each student presents one or more reviews of literature on assigned topics.

HORT. 521. TECHNICAL PRACTICES IN LANDSCAPE CONTRACTING (2-12) Commercial and technical operations in landscape contracting and maintenance services. Prerequisites: Hort. 460, 461. *Professor Bracken*

HORT. 523. PROPAGATION AND IMPROVEMENT OF VEGETABLE AND FLOWER CROPS (3) Methods and special techniques in breeding of flowers and vegetables; maintenance of seed stocks and seed production. Prerequisite: Hort. 444. *Professor Odland*

HORT. 524. EXPERIMENTAL PROCEDURES IN HORTICULTURAL RESEARCH (3) *Professor Larson*

HORT. 525. HORTICULTURAL RESEARCH TECHNIQUES (3) Practice in and comparison of methods and apparatus used in horticultural research. *Professor White*

HORT. 526. RESEARCH IN FLORICULTURE (2-12) Greenhouse research and review of literature. Prerequisite or concurrent: Hort. 427, 428. *Professor Seeley*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Hort. 418.	Subtropical and Tropical Fruits (3)	*Professor White*
Hort. 420.	Advanced Commercial Vegetable Production (3)	*Professor Odland*
Hort. 423.	Advanced Fruit and Vegetable Processing (3)	
Hort. 424.	Advanced Olericulture (3-6)	*Professor Odland*
Hort. 427.	Advanced Floriculture (3)	
Hort. 428.	Advanced Floriculture (3)	
Hort. 444.	Advanced Plant Breeding (3-6)	*Professor Larson*
Hort. 445.	Principles of Pomology (3)	*Professor White*
Hort. 446.	Advanced Pomology (3)	*Professor White*
Hort. 447.	Problems in Pomology (1-3)	*Professor White*
Hort. 453.	Nursery Principles and Practice (3)	*Professor Meahl*
Hort. 454.	Landscape Problems (3-6)	*Professor Bracken*
Hort. 455.	Landscape Problems (3-6)	*Professor Bracken*
Hort. 456.	Problems in Nursery Practice (3)	*Professor Meahl*
Hort. 460.	Landscape Horticulture Projects (3)	*Professor Bracken*
Hort. 461.	Parks and Park Administration (3)	*Professor Bracken*
Hort. 462.	Institutional Grounds and Their Administration (3)	*Professor Bracken*
Hort. 463.	Landscape Horticulture Projects (1-6)	*Professor Bracken*

HOTEL ADMINISTRATION

Professor Esther A. Atkinson, M.S.
Head of the Department of Hotel and Institution Administration

The following courses may be taken for graduate credit under the restrictions in force:

Hl. Adm. 440.	Hotel Operational Liabilities (2)	*Professor Bower*
Hl. Adm. 445.	Hotel Organization and Operation (3)	*Professor Bower*

HOUSING AND HOME EQUIPMENT

Professor Delpha E. Wiesendanger, M.S.
Acting Head of the Department of Home Management, Housing, and Art

Hs. Eqp. 500. Research in Housing and Equipment (1-6 per semester)

Hs. Eqp. 501. Thesis (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Hs. Eqp. 413.	Home Equipment (3)	
Hs. Eqp. 470, 470X.	Housing the Family (2-3)	*Professor Wiesendanger*

INDUSTRIAL ARTS

Professor S. Lewis Land, M.S., Ph.D.
Head of the Department of Industrial Education
Professor John F. Friese, M.S.

Ind. Arts 574. History and Philosophy of Industrial Arts (2-3) Historical developments and concurrent educational philosophies of industrial arts in American education. Prerequisites: 6 hours in professional courses in industrial arts and teaching experience.

Ind. Arts 575. Problems in Industrial Arts Education (2-3) Subject matter, projects, methods of manual and informational teaching, aids and devices, selection of text and reference materials, personnel organization, shop management, problem pupils. Prerequisites: 6 hours in professional courses in industrial arts and teaching experience.

Ind. Arts 576. Supervision and Administration of Industrial Arts Education (2-3) How to organize, supervise, and administer functioning programs of industrial arts; the duties of a supervisor and director of industrial arts. Prerequisites: 6 hours in professional courses in industrial arts and teaching experience.

Ind. Arts 577. Testing in Industrial Arts (2-3) Construction of informal manipulative and written tests; use of standardized mechanical aptitude and achievement tests; construction and use of rating scales; scoring and grading; interpretation of test results. Prerequisites: 6 hours in professional courses in industrial arts and teaching experience.

Ind. Arts 578. Research in Industrial Arts (1-18) Individual research in industrial arts for dissertations and lesser research studies. Prerequisite: 6 hours in professional courses in industrial arts.

Unit A. Common Research Techniques in Industrial Arts (2-3)

Unit B. Individual Research Problems in Industrial Arts (1-15)

Ind. Arts 579. Master's Thesis in Industrial Arts (1-6) Conferences and assignments relating to the preparation of an acceptable thesis for the Master of Science or Master of Education degrees. Prerequisite: 6 hours in professional courses in industrial arts.

Ind. Arts 580. Seminar in Industrial Arts (2-9) Directed intensive study, investigation, or research in selected phases of the program; reports and constructive criticism. Prerequisites: 6 hours in professional courses in industrial arts and teaching experience.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Ind. Arts 407, 407X. Industrial Arts Education (2-3)
Ind. Arts 421, 421X. Curriculum Materials in Industrial Arts (2-3)
Ind. Arts 470, 470X. Problems in Senior High School Industrial Arts (2-3)

INDUSTRIAL EDUCATION

PROFESSOR S. LEWIS LAND, M.S., Ph.D.
Head of the Department

IND. ED. 501v. SEMINAR IN VOCATIONAL EDUCATION (1-12) Conferences, investigations, and discussion for advanced students and mature persons who have had experience as teachers, supervisors, or administrators.

IND. ED. 506v. ADMINISTRATION OF VOCATIONAL EDUCATION (1-6) The job of the local director of industrial education in organizing and developing city and other local programs of industrial education. Prerequisite: 6 semester hours in industrial education or valid director's certificate, equivalent training and experience.

IND. ED. 510v. VOCATIONAL EDUCATION FOR ADMINISTRATORS (2-3) Designed for school administrators and supervisors who desire an understanding of practical arts and vocational education. Prerequisite: Ind. Ed. 1v or trade or teaching experience.

IND. ED. 550v. RESEARCH IN VOCATIONAL EDUCATION (1-12) Research techniques in vocational education and research problems in connection with work of evening, part-time, or day vocational industrial schools.

Unit A. Research Techniques in Vocational Industrial Education (2-3)
Unit B. Individual Research Problems in Vocational Industrial Education (1-10)

IND. ED. 555v. CURRENT PROBLEMS IN VOCATIONAL EDUCATION (1-6) Recent trends and developments in part-time, full-time, and evening school education, involving critical analysis of objectives, content, and outcome.

Unit A. Changing Industrial, Economic, and Social Conditions (1)
Unit B. Policies and Program of the American Vocational Association (1)
Unit C. Federal and State Vocational Legislation, Present and Pending (1)
Unit D. Financing Vocational Education (1)
Unit E. Current Administrative Problems in Vocational Education (1)
Unit F. Current Administrative Problems in Vocational Education (continued) (1)

IND. ED. 558v. FRONTIER PROBLEMS IN VOCATIONAL INDUSTRIAL EDUCATION (2-3 per unit)

Unit A. Federal Legislation (2-3)
Unit B. Present-Day Local Personnel and Curriculum Problems (2-3)
Unit C. State and Local Supervision and Administration (2-3)

IND. ED. 560v. PHILOSOPHY OF INDUSTRIAL EDUCATION (2-3) Principles and beliefs upon which progressive industrial education rests; basic concepts underlying practical arts and vocational education; literature for evaluating instructional practices. Prerequisite: 12 hours in industrial education or teaching experience.

IND. ED. 590v. MASTER'S THESIS IN INDUSTRIAL EDUCATION (2-6) Conferences and assignments relating to the selection and preparation of an acceptable thesis for the degree of Master of Education or Master of Science.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

IND. ED. 401v, 401vX. HISTORY OF INDUSTRIAL EDUCATION (2-3)
IND. ED. 402v, 402vX. SUPERVISION OF VOCATIONAL EDUCATION (2-3)
IND. ED. 403v, 403vX. SUPERVISED FIELD WORK (1-6)
IND. ED. 405v, 405vX. CONFERENCE LEADER TRAINING (2-3)
IND. ED. 408v, 408vX. OCCUPATIONS (2-3)
IND. ED. 409v, 409vX. TESTS AND MEASUREMENTS (2-3)
IND. ED. 412v, 412vX. SPECIAL PROBLEMS IN VOCATIONAL EDUCATION (2-4)
IND. ED. 414v, 414vX. VOCATIONAL EDUCATIONAL GUIDANCE (2-3)
IND. ED. 415v, 415vX. PROBLEMS IN CO-ORDINATING VOCATIONAL EDUCATION (2-3)
IND. ED. 418v, 418vX. PROBLEMS IN AUDIO-VISUAL AIDS IN INDUSTRIAL EDUCATION (2-3)
IND. ED. 420v, 420vX. OCCUPATIONAL HYGIENE (2-3)
IND. ED. 425v, 425vX. WORKSHOP IN INDUSTRIAL EDUCATION (1-6)
IND. ED. 427v, 427vX. ADVANCED COURSE OF STUDY BUILDING (2-3)
IND. ED. 430v, 430vX. SAFETY EDUCATION FOR VOCATIONAL TEACHERS (2-3)
IND. ED. 446v, 446vX. IMPROVEMENT OF INSTRUCTION IN VOCATIONAL EDUCATION (2-4)
IND. ED. 450v, 450vX. SHOP LAYOUT AND MANAGEMENT (2-3)
IND. ED. 458v. EMERGING PROBLEMS IN VOCATIONAL EDUCATION (1-7)
Unit A. Federal and State Laws Relating to Vocational Education (1)
Unit B. Framework of Federal, State, and Local Administrative Agencies (1)
Unit C. Federal, State, and Local Policies and Plans for Vocational Education (1)
Unit D. Local Administration of Vocational Education (1)
Unit E. Labor Laws and Labor Relations Affecting Education (1)
Unit F. Vocational Training for War and Postwar Eras (1)
Unit G. Problems in Vocational Rehabilitation of the Physically Handicapped (1)
IND. ED. 460S. PROBLEMS IN VOCATIONAL REHABILITATION OF THE HANDICAPPED (1-6)
Unit A. The Counseling Interview in Vocational Rehabilitation (1-3)
Unit B. Occupational Information and Placement Techniques in Vocational Rehabilitation (1-3)

INDUSTRIAL ENGINEERING

PROFESSOR CLARENCE E. BULLINGER, I.E., M.S.
Head of the Department

I.E. 501. MANUFACTURING METHODS (2-8) Special projects including investigation; experimentation, design, and research of some one or more special types of manufacture. *Professor Bullinger*

I.E. 502. Management Methods (3-6) Intensive study of the newer phases of scientific management, including production control and application of Gantt charts; research on special problems. *Professor Bullinger*

I.E. 503. Personnel Relations (2-8) Research on special topics. *Professor Bullinger*

I.E. 505. Graphical Computation (2-10) The construction of natural and logarithmic scales, applications of various co-ordinate papers and construction of nomographic or alignment charts; determination of empirical formulae from engineering data. *Professor Babcock*

I.E. 506. Time and Motion Study (3-9) Machine data, elementary and fundamental machine times; determination of fatigue curves; design of Barth slide rules, micromotion study and chart plotting of micromotion results; chronocyclegraph study. *Professor Anderson*

I.E. 507. Budgetary Control and Standard Costs (3-6) Divisional budgets as control media; establishing standard cost data, standard cost accounting procedures, and the use of cost variances in controlling manufacturing operations. Prerequisite: I.E. 401. *Professor Hussey*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

I.E. 401. Industrial Accounts (4) *Professor Hussey*
I.E. 404. Scientific Management (2) *Professor Bullinger*
I.E. 406. Factory Planning (2) *Professor Babcock*
I.E. 409. Personnel Administration (3) *Professor Thomas*
I.E. 411. Manufacturing Budgets (2) *Professor Hussey*
I.E. 422a,b,c,d,e,f. Industrial Engineering Problems (2 per unit) *Professors Babcock, Bullinger, Anderson, Hussey, and Thomas*
I.E. 423. Quality Control (2-3) *Professor Bullinger*
I.E. 424. Job Evaluation (3) *Professor Thomas*
I.E. 429. Plastic Working of Metals (3) *Professor Roscoe*

INSTITUTION ADMINISTRATION

Professor Esther A. Atkinson, M.S.
Head of the Department of Hotel and Institution Administration

In. Adm. 500. Research in Institution Administration (1-6 per semester)

In. Adm. 501. Thesis (1-15)

In. Adm. 502. Problems in Institutional Administration (3-6) Individual study of problems in institutional administration. Prerequisites: In. Adm. 326, 330. *Professor Atkinson*

LATIN

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

In. Adm. 410. Tea Room Management (3)
In. Adm. 437a,b,cS. School Cafeteria Problems (1-3) Units A, B, C, 1 credit per unit.
In. Adm. 438. School Lunch Administration (3)
In. Adm. 461. Institution Administration (3)
In. Adm. 462. Institution Experience (3)

ITALIAN

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

It. 571. Seminar in Italian Literature (3) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

JOURNALISM

Professor Franklin C. Banner, M.A.
Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

Journ. 416. Advanced Copy Reading (3)
Journ. 424. Advanced Reporting (3)
Journ. 430. Supervision and Management of School Publications (3)
Journ. 441. Advanced Advertising Copywriting (3)
Journ. 480. Problems of Publishing (3)

LATIN

Professor Robert E. Dengler, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

Latin 500. Latin Literature (3) Lectures and collateral readings on the major forms of Latin literature; readings in the original Latin to supplement the lectures.
Professor Dengler

LATIN 501. ROMAN RELIGION AND PHILOSOPHY (3) Development of religious concepts at Rome from primitive Italic origins to the advanced forms that culminated in Roman Stoicism. *Professor Krauss*

LATIN 502. LATIN EPIGRAPHY (3) Lectures and readings on Roman inscriptions; illustrative exercises. *Professor Krauss*

LATIN 503. LATIN PALEOGRAPHY (3) The Latin alphabet, writing materials, Roman book and cursive hands; illustrative exercises. *Professor Dengler*

LATIN 504. ROMAN TOPOGRAPHY (3) The physical development of the city of Rome, its walls, aqueducts, bridges, streets, fora, public buildings, temples, etc.; building materials and methods of construction. *Professor Krauss*

LATIN 510. LATIN SEMINAR (3)

LATIN 518. LATIN RESEARCH (1-3) Prosecution of an assigned problem under the guidance of a member of the department. *Professor Dengler*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

LATIN 428. LUCRETIUS (3) *Professor Krauss*
LATIN 429. QUINTILIAN (3) *Professor Krauss*
LATIN 431. JUVENAL (3) *Professor Krauss*
LATIN 436S. FUNCTIONAL PROBLEMS IN LATIN (3)
LATIN 440a,b,c,dS. COLLEGE LATIN (3-12) *Professor Dengler*

LIBRARY SCIENCE

Consult LIBRARIAN RALPH W. MCCOMB, M.A.

The following courses may be taken for graduate credit under the restrictions in force:

LIB. SCI. 403S. INTERMEDIATE DICTIONARY CATALOGING AND SUBJECT HEADINGS (2-3)

LIB. SCI. 405S. INTERMEDIATE REFERENCE WORK AND BIBLIOGRAPHY (2-3)

MATHEMATICS

PROFESSOR ORRIN FRINK, JR., M.A., Ph.D.
Head of the Department

MATH. 500. ANALYTICAL MECHANICS (3) An exposition of rigid dynamics, the potential function, and Lagrange's equations. Prerequisite: Math. 419.

MATH. 501. THEORY OF FUNCTIONS OF A REAL VARIABLE (3) Theory of real functions, sets, measure, derivatives, and integrals. Prerequisite: Math. 420.

MATH. 502. THEORY OF FUNCTIONS OF A REAL VARIABLE (3) Continuation of Math. 501.

MATH. 503. FOURIER SERIES AND HARMONIC FUNCTIONS (3) Fourier series and integrals; spherical harmonics, Bessel functions, etc., with special emphasis on their applications. Prerequisites: Math. 90, 420.

MATH. 505. INTEGRAL EQUATIONS (3) Fredholm and Volterra equations, and applications. Prerequisite: Math. 421.

MATH. 507. CALCULUS OF VARIATIONS (3) Prerequisites: Math. 90, 421.

MATH. 508. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (3) Development of the complex number system; theory of analytic functions. Prerequisite: Math. 421.

MATH. 509. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (3) Continuation of Math. 508.

MATH. 510. THEORY OF GROUPS (3) General properties of groups with applications. Prerequisite: mathematical maturity.

MATH. 511. INTRODUCTION TO HIGHER ALGEBRA (3) Algebra of matrices, determinants, bilinear and quadratic forms. Prerequisite: Math. 11.

MATH. 512. INTRODUCTION TO HIGHER ALGEBRA (3) Continuation of Math 511.

MATH. 513. ADVANCED ANALYTIC GEOMETRY (3) Introduction of homogeneous co-ordinates and their use in the study of projective properties. Prerequisite: Math. 30.

MATH. 514. ADVANCED ANALYTIC GEOMETRY (3) Continuation of Math. 513.

MATH. 520. PROJECTIVE GEOMETRY (3) A general study of the subject from the postulational standpoint. Prerequisite: Math. 30. Alternate years or as required.

MATH. 521. PROJECTIVE GEOMETRY (3) Continuation of Math. 520.

MATH. 522. METRIC DIFFERENTIAL GEOMETRY (3) The usual classical treatment of the subject. Prerequisite: Math. 11 or 30.

MATH. 523. DIFFERENTIAL GEOMETRY (3) Continuation of Math. 522.

MATH. 530. TOPOLOGY (3) Topological spaces, combinatorial topology, applications to algebra and analysis. Prerequisite: mathematical maturity.

MATH. 531. TOPOLOGY (3) Continuation of Math. 530.

MATH. 532. THEORY OF SETS (3) Theory of abstract sets; cardinal and ordinal numbers; sets of points in Euclidean space and in general metric space; theory of measure with applications to geometry and function theory. Prerequisite: general mathematical maturity.

MATH. 533. THEORY OF SETS (3) Continuation of Math. 532. Prerequisite: Math. 532.

MATH. 534. THEORY OF ALGEBRAIC NUMBERS (3) An introduction to the number theory of quadratic fields, with a study of the theory of ideals in quadratic and higher fields, with application. Prerequisite: Math. 404.

MATH. 535. MODERN ALGEBRAIC THEORIES (3) Algebraic invariants, matrices, quadratic and Hermitian forms, Galois theory of equations, modular systems, etc. Prerequisite: general mathematical maturity.

MATH. 536. MODERN ALGEBRAIC THEORIES (3) Continuation of Math. 535.

MATH. 550. MATHEMATICAL LOGIC (3) The logical basis of mathematics and its ultimate nature. Prerequisite: general mathematical maturity.

MATH. 552. NUMERICAL METHODS (3) Procedures for practical calculation, including interpolation, solution of equations, iterative methods, harmonic analysis, and use of modern calculating equipment. Prerequisite: Math. 420.

MATH. 553. NUMERICAL METHODS (3) Continuation of Math. 552. Prerequisite: Math. 552.

MATH. 560. THEORY OF DIFFERENTIAL EQUATIONS (3) Prerequisites: Math. 90, 421.

MATH. 561. THEORY OF DIFFERENTIAL EQUATIONS (3) Continuation of Math. 560.

MATH. 570. SPECIAL TOPICS IN GEOMETRY (3-6)

MATH. 571. SPECIAL TOPICS IN ANALYSIS (3-6)

MATH. 572. SPECIAL TOPICS IN ALGEBRA (3-6)

MATH. 573. SPECIAL TOPICS IN APPLIED MATHEMATICS (3-6)

MATH. 575. MATHEMATICS SEMINAR (2-6) Selected topics from recent mathematical developments. Prerequisite: general mathematical maturity.

MATH. 576. MATHEMATICS SEMINAR (2-6) Continuation of Math. 575.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MATH. 403. MODERN METHODS IN GEOMETRY (3)
MATH. 404. THEORY OF NUMBERS (3)
MATH. 405. PARTIAL DIFFERENTIAL EQUATIONS (3)
MATH. 407. FOUNDATIONS OF ALGEBRA AND GEOMETRY (3)
MATH. 408. APPLICATIONS OF MATHEMATICS (3)
MATH. 409. THEORY OF PROBABILITY (3)
MATH. 410. STATISTICAL METHODS (3)
MATH. 411. FINITE DIFFERENCES (3)
MATH. 417. VECTOR ANALYSIS (3)

MATH. 419. ANALYTICAL MECHANICS (3)
MATH. 420. ADVANCED CALCULUS (3)
MATH. 421. ADVANCED CALCULUS (3)
MATH. 424. LEAST SQUARES (2)
MATH. 425. CURVE FITTING (1)
MATH. 431. DIFFERENTIAL EQUATIONS (3)
MATH. 441. THEORY OF EQUATIONS (3)
MATH. 451. INTRODUCTION TO APPLIED MATHEMATICS (3-6)
MATH. 452. INTRODUCTION TO APPLIED MATHEMATICS (3-6)
MATH. 471. FOUNDATIONS OF ALGEBRA (3)
MATH. 472. FOUNDATIONS OF GEOMETRY (3)
MATH. 481. VECTORS AND MATRICES (3)

MECHANICAL ENGINEERING

PROFESSOR NORMAN R. SPARKS, M.E.
Head of the Department

M.E. 502. ADVANCED GAS TURBINES (3-6) The thermodynamic and stress analysis design of gas turbine and compressor units. Prerequisite: M.E. 409.

M.E. 504. ADVANCED THERMODYNAMICS (3-6) Pure and applied thermodynamics including its application to advanced engineering problems; collateral reading and discussion of the classical works on the subject. Prerequisite: M.E. 3 or 104.

M.E. 505. HEAT TRANSMISSION (3-6) Applications of principles of heat transfer to efficient design of mechanical engineering equipment. Prerequisite: M.E. 412.

M.E. 506. MECHANICAL ENGINEERING SEMINAR (1-4) Advanced courses adapted to the individual requirements of graduates in mechanical engineering.

M.E. 507. ADVANCED INTERNAL COMBUSTION ENGINES (3) Design and performance of both carburetor and fuel injection type reciprocating engines primarily from the thermodynamic viewpoint, with emphasis on the economics of operation. Prerequisites: M.E. 413, 504.

M.E. 508. MECHANICAL ENGINEERING RESEARCH (1-9) Research related to the mechanical engineering major subject; work must show evidence of original thinking; may be scheduled as thesis work for the M.S. degree.

M.E. DES. 502. FRICTION AND LUBRICATION (3) The hydrodynamic theory of lubrication, and the methods of applying it to bearing design, together with a survey of methods of testing lubricants.

M.E. DES. 505. ADVANCED DYNAMICS OF MACHINES (3-6) Linear and torsional vibrations in and balancing of rotating and reciprocating machinery; an exact analysis of the stresses produced by these and other dynamic forces in machine parts. Prerequisites: Mchs. 12, M.E. Des. 8.

M.E. Lab. 501. Investigation Projects (2-6) Special experimental studies or investigations in mechanical engineering, adapted to individual requirements.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

M.E. 401a,b,c,d. Mechanical Engineering (3-12)
M.E. 402. Air Conditioning (3)
M.E. 408. Steam Turbines (3)
M.E. 409. Gas Turbines (3)
M.E. 410. Steam Power Plants (3)
M.E. 411. Refrigeration (3)
M.E. 412. Fundamentals of Heat Transfer (3)
M.E. 413. Internal Combustion Engines (3)
M.E. 416. Resistance and Powering of Ships (3)
M.E. Des. 402. Design of Machine Tools (3)
M.E. Des. 403. Advanced Machine Design Problems (3)
M.E. Des. 404. Machine Design Analysis (3)

METALLURGY

Professor Jay W. Fredrickson, Ph.D.
Chief of the Division

Met. 500. Metallurgical Research (3-15 per semester) Research on special topics; conferences, reading, and library work. Results may be embodied in a thesis. Prerequisites: Met. 411, 413.

Met. 501. Metallurgical Problems (1-6 per semester) Independent study of special problems in metallurgy. Prerequisites: Met. 411, 413.

Met. 502. Metallurgical Seminar (1 per semester) Conferences, reading, and reports. Required of all graduate students in metallurgy.

Met. 515. Corrosion and Protection of Metallic Surfaces (3) Phenomena and theories of metallic corrosion; chemistry and metallurgy of metal protection. Prerequisites: Met. 411, 413. *Professor Read*

Met. 516. Mechanical Metallurgy (3) Theories of plastic flow in polycrystalline metals; calculations of simple and combined stresses and application to metal forming and mechanical tests. Prerequisites: Met. 411, 413. *Professor Prater*

Met. 517. Advanced Nonferrous Metallurgy (3) Theory of electrorefining, electrowinning, and processes involving the vapor phase; physical chemistry of roasting and leaching. Prerequisites: Met. 411, 413. *Professor Read*

Met. 518. Constitution of Metallurgical Systems (3) Application of thermodynamic principles to study of heterogeneous equilibrium in alloy, slag, and slag-metal systems. Prerequisites: Met. 411, 413. *Professor Davis*

MET. 519. ADVANCED FERROUS METALLURGY (3) Physicochemical principles in the smelting and refining of iron and steel; slag control; solidification and primary forging of steel. Prerequisites: Met. 411, 413. *Professor Davis*

MET. 520. FOUNDRY METALLURGY (3) Principles of foundry metallurgy; application to foundry operations for various ferrous and nonferrous casting alloys. Prerequisites: Met. 411, 413. *Professor Lindsay*

MET. 521. ENGINEERING ALLOYS (3) Requirements and applications of industrial alloys: mechanical, thermal, electrical, and magnetic properties. Prerequisites: Met. 411, 413. *Professor Lindsay*

MET. 522. SOLID PHASE REACTIONS IN METALS (3) Mechanism and rate determining factors in solid phase reactions in metals; diffusion processes, nucleation theory, precipitation from solid solution, eutectoid, decomposition and order-disorder phenomena. Prerequisites: Met. 411, 413. *Professor Lindsay*

MET. 523. BEHAVIOR OF METAL CRYSTALS (3) Plastic action in single crystals of metals and in polycrystalline metals, theoretical crystal plasticity, recovery, and recrystallization, deformation and recrystallization textures, anistropy in general. Prerequisites: Met. 411, 413. *Professor Fredrickson*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MET. 405. FERROUS METALLOGRAPHY (3)
MET. 406. NONFERROUS METALLOGRAPHY (3)
MET. 407. METALLURGICAL ENGINEERING I (3)
MET. 408. METALLURGICAL ENGINEERING II (3)
MET. 409. METALLURGICAL INVESTIGATIONS I (3)
MET. 410. METALLURGICAL INVESTIGATIONS II (3)
MET. 411. ADVANCED PHYSICAL METALLURGY (3)
MET. 412. EXPERIMENTAL METALLURGY (3)
MET. 413. ADVANCED CHEMICAL METALLURGY (3)

METEOROLOGY

PROFESSOR HANS NEUBERGER, D.Sc.
Chief of the Division

METEOR. 500. METEOROLOGICAL SEMINAR (1-3) Discussion of meteorological reports and papers; scientific outlook. Prerequisites: Meteor. 421, 441, 451.

METEOR. 501. METEOROLOGICAL RESEARCH (3-15) Research work in physical, synoptic, dynamic meteorology; climatology. Prerequisites: a minimum of one year of physics, calculus, and differential equations, 15 credits in meteorology.

METEOR. 502. SELECTED TOPICS OF ADVANCED METEOROLOGY (2) Lectures, review, and discussion of current problems in meteorology. Prerequisite: a minimum of 15 credits in meteorology.

METEOR. 504. THEORETICAL AND DYNAMIC METEOROLOGY (3) Mathematical analysis of meteorological phenomena; theory of circulation; deformation fields. Prerequisite: Meteor. 452.

METEOR. 505. BIOCLIMATOLOGY (2) Climatic phenomena in their relation to life. Prerequisite: Meteor. 372.

METEOR. 506. ADVANCED METEOROLOGICAL ANALYSIS (2-6) Physical analysis of atmospheric phenomena; synoptic analysis of weather phenomena for advanced students. Prerequisite: Meteor. 421.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

METEOR. 421. SYNOPTIC METEOROLOGY I (3)
METEOR. 422. SYNOPTIC METEOROLOGY II (3)
METEOR. 431. SYNOPTIC METEOROLOGY LABORATORY I (2)
METEOR. 432. SYNOPTIC METEOROLOGY LABORATORY II (2-10)
METEOR. 441. PHYSICAL METEOROLOGY I (2)
METEOR. 442. PHYSICAL METEOROLOGY II (2)
METEOR. 451. DYNAMIC METEOROLOGY I (3)
METEOR. 452. DYNAMIC METEOROLOGY II (3)
METEOR. 453. PROBLEMS IN DYNAMIC METEOROLOGY (1)
METEOR. 492. METEOROLOGICAL SEMINAR (2)

MINERAL ECONOMICS

PROFESSOR JOHN D. RIDGE, M.S., Ph.D.
Chief of the Division

MIN. ECON. 500. MARKETING OF MINERALS AND MINERAL PRODUCTS (3-6) Research in mineral marketing problems. Prerequisite: Min. Econ. 453.

MIN. ECON. 501. RESEARCH IN MINERAL ECONOMICS (3-6) Investigation in specialized fields of research in mineral economics. Prerequisite: Min. Econ. 453.

MIN. ECON. 502. TECHNOLOGIC INFLUENCES (3-9) The relationship of technologic advancements to the financial development of the mineral industries. Prerequisites: Min. Econ. 87, 483.

MIN. ECON. 505. PROBLEMS OF MINERAL ECONOMICS (3-12) The determination of basic technologic-economic patterns of selected mineral industries. Prerequisite: Min. Econ. 87.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MIN. ECON. 400. SEMINAR (1)
MIN. ECON. 453. NONMETALLIC MINERALS (3)
MIN. ECON. 483. THE METALS AND THEIR ORES (3)

MIN. ECON. 484. THE SOLID FUELS (3)
MIN. ECON. 486. PETROLEUM AND NATURAL GAS ECONOMICS (3)
MIN. ECON. 490. MINERAL VALUATION (3)
MIN. ECON. 491. ANALYSIS OF MINERAL DATA (2)

MINERAL PREPARATION

PROFESSOR H. BEECHER CHARMBURY, M.S., Ph.D.
Chief of the Division

MIN. PREP. 502. FROTH FLOTATION AND AGGLOMERATION (3) An intensive study of the theory and applications of froth flotation and agglomeration. Prerequisite: Min. Prep. 405. *Professor Sun*

MIN. PREP. 504. MINERAL PREPARATION RESEARCH (3-10) Research work on specific problems in mineral preparation. Prerequisite: Min. Prep. 405 or 410.

MIN. PREP. 505. GRAVITY PROCESSES AND MISCELLANEOUS METHODS OF MINERAL PREPARATION (3) An intensive study of the theory and applications of gravity, magnetic, electrostatic, centrifugal, and dense-media processes of mineral concentration. Prerequisite: Min. Prep. 405.

MIN. PREP. 506. MINERAL PREPARATION PLANT DESIGN (3-10) The layout, design, and selection of equipment for specific mineral preparation plant projects. Prerequisite: Min. Prep. 405. *Professor Mitchell*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MIN. PREP. 400. MINERAL PREPARATION SEMINAR (1)
MIN. PREP. 403. FLOWSHEETS OF MINERAL PREPARATION PLANTS (2)
MIN. PREP. 404. PLANT LAYOUT AND DESIGN (3)
MIN. PREP. 405. UNIT OPERATIONS (3)
MIN. PREP. 406. MINERAL PREPARATION TESTING (2)
MIN. PREP. 410. COAL PREPARATION (3)

MINERALOGY

PROFESSOR PAUL D. KRYNINE, Ph.D.
Chief of the Division

MIN. 500. PHYSICAL MINERALOGY (3) Optical methods and measurement of optical constants of minerals. *Professors Krynine and Bates*

MIN. 501a. PETROLOGY (3-6) Microscopic study of rocks, emphasizing classification and genetic relationships. *Professors Krynine, Osborn, and Griffiths*

*Min. 502a. Mineralogical Research (3-18) An original study of some mineralogical problem, results of which may be applied on the thesis requirements.

Min. 504. Theoretical Mineralogy (2) Selected topics in crystal chemistry and crystal physics applied to solid solution, polymorphism, crystal growth, and related phenomena; laboratory studies of identification techniques including X-ray diffraction. Prerequisite: Min. 461. *Professor Bates*

Min. 505. Mineralogy Seminar (1-2) Reading, presentation, and discussion of literature dealing with various phases of theoretical mineralogy. Topics are selected to meet the interests of the majority of the students.
Professors Krynine, Osborn, Bates, and Griffiths

Min. 507. Physicochemical Petrography (3) Advanced work in the constitution and phase relations of inorganic crystals and liquids; special emphasis on silicate compounds and glasses. Prerequisite: Min. 483. *Professor Osborn*

Min. 508. Physicochemical Petrology (3) Application of the principles of physicochemical petrography to the origin of igneous and metamorphic rocks; the distribution of elements in the earth's crust. Prerequisite: Min. 507.
Professor Osborn

†Min. 510. Metamorphism (2-6) A detailed review of chemical mineralogical and structural changes that take place during metamorphism. Prerequisite: Min. 483. *Professors Krynine, Osborn, Bates, and Griffiths*

Min. 511. Basic Sedimentology (3-4) Composition, texture, structure, mass properties of sediments; dynamic processes in complex natural systems; sedimentary stages: weathering, erosion, transport, deposition, and lithification. Prerequisite: Min. 483. Concurrent: Min. 513. *Professor Krynine*

Min. 512. Basic Sedimentology, Continued (3-4) Diastrophism and tectonic background of sedimentation; depositional loci; classification of sediments: the quartzites, graywackes, and arkoses; chemical sediments; paleogeography, paleoclimatology, oil finding. Prerequisite: Min. 511. Concurrent: Min. 514.
Professor Krynine

Min. 513. Methods of Analysis of Sediments (2) Principles and practices used in analyzing sedimentary rocks for size, shape, and accessory (heavy) minerals. Concurrent: Min. 511. *Professor Griffiths*

Min. 514. Applied Sedimentology (2) Design and control in analysis of sedimentary rocks; application of these techniques to industrial problems. Concurrent: Min. 512. *Professor Griffiths*

Min. 515. Mineralogy of Clays and Other Fine-Grained Materials (2-3) The physical and chemical properties of clay minerals; importance and application of X-ray diffraction, differential thermal analysis, light and electron microscopy. Prerequisite: Min. 460. *Professors Bates and Griffiths*

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* Credits to be arranged, 3-9 per semester.

† Credits to be arranged, 2-4 per semester.

MIN. 516. PETROLOGY OF FINE-GRAINED SEDIMENTS (2-3) The fine-grained sedimentary rocks and their industrial applications. Prerequisite: Min. 515.
Professors Griffiths and Bates

‡MIN. 517. EUROPEAN SEDIMENTS (1-6) Interpretative microscopic and hand specimen study of selected rock suites from Europe and Asia; correlation with paleogeographic and tectonic data. Prerequisites: Min. 512, 514. *Professor Krynine*

†MIN. 518. AMERICAN SEDIMENTS (2-8) Thin section, heavy residue, textural and field data of arkoses, graywackes, quartzites, and carbonates from representative North American sedimentary provinces. Prerequisites: Min. 512, 514, 516.
Professor Krynine

§MIN. 519. OIL RESERVOIR PETROLOGY (2-6) The petrographic fundamentals controlling porosity, storage capacity, oil accumulation, effective permeability, fluid yield and retention, exploration and production methods. Prerequisites: Min. 512, 514, 516. *Professors Krynine and Griffiths*

MIN. 520. STUDY OF ACCESSORY MINERALS (2-4) Detailed study of accessory (heavy) minerals; their significance in problems of provenance, petrogenesis, mineral stratigraphy, and paleogeography. Prerequisites: Min. 511, 512, 513, 514.
Professor Griffiths

MIN. 521. COLOR IN MINERALS (1-2) The nature of light absorption as a function of chemical composition for solutions, glasses, and minerals. *Professor Weyl*

§MIN. 522. THE ELECTRON MICROSCOPE IN MINERALOGICAL AND GEOLOGICAL PROBLEMS (2-6) Laboratory investigation of geological subjects at high magnification; correlation of data with those obtained by other methods of study.
Professor Bates

§MIN. 523. X-RAY DIFFRACTION STUDIES OF MINERALS (2-6) Investigation of mineralogical problems with X-rays. Practicum includes preparation of samples, use of X-ray apparatus, and interpretation of patterns. Prerequisite: Min. 461.
Professor Bates

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MIN. 460. PHYSICAL MINERALOGY (3) *Professor Wright*
MIN. 461. DESCRIPTIVE MINERALOGY (4) *Professor Bates*
MIN. 483. PETROGRAPHY (4) *Professor Griffiths*

‡ Credits to be arranged, 1-3 per semester.
† Credits to be arranged, 2-4 per esemester.
§ Credits to be arranged, 2-3 per semester.

MINING

Professor Arnold W. Asman, B.Sc.
Chief of the Division

Mng. 500. Mining Seminar (2) Conferences, reading, and reports. Scientific management; public relations; technological developments. Required of all graduate students in mining engineering.

Mng. 501. Mine Engineering (3) Mine mechanization problems. The selection of the most suitable equipment for various conditions. Prerequisite: Mng. 488.

Mng. 504. Mining Research (3-10 per semester) Research work on specific problems in physics of mining and mine mechanization. Prerequisite: Mng. 481.

Mng. 506. Mine and Mine Plant Design (3-10) The layout, design, and selection of equipment for specific mining and mine plant projects. Prerequisite: Mng. 499.

Mng. 520. Mine Planning Using Cycle Studies (3-6) Highly productive cycles of mine section operation are developed by use of time and method studies of the various sub-cycles involved. Prerequisite: Mng. 72.

Mng. 521. Mathematical Analysis of Mine Layouts (3) Proportioning layouts in regard to mineral available, distances, and centroids of mining areas; incremental and sub-cycle costs. Prerequisite: Mng. 488.

Mng. 522. Rock Mechanics (3-6) A detailed study of the physical properties of rocks as affecting the design of underground openings; testing procedures, calculations, and design. Prerequisite: Mng. 499.

Mng. 523. Mine Dusts (3) Detailed studies of methods of collecting, sampling, and determining the amount, size, and mineral content of dust in mine atmospheres; methods of dust control. Prerequisite: Mng. 481.

Mng. 524. Underground Mining Power Distribution Systems (3-6) Calculations involved in the design of power applications and systems for mines; electrical, compressed air; Diesels; package power for extremely gassy conditions; sectionalizing; loads and load centers. Prerequisite: Mng. 488.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Mng. 400. Mine Safety Engineering (2)
Mng. 481. Physics of Mining (4)
Mng. 484. Mine Cost Control (2)
Mng. 488. Advanced Mine Mechanization (3)
Mng. 494. Mine Management Engineering (3)
Mng. 499. Advanced Mining Design (2)

MUSIC

PROFESSOR HUMMEL FISHBURN, M.A., Mus.D.
Head of the Department

MUSIC 503-506. ADVANCED STRINGED INSTRUMENTS (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 103-106. Fee $25 per course. *Professor Karhan*

MUSIC 511-514. ADVANCED PIANO (3 per course) Piano literature of all periods; stress laid on developing technique and preparing for public performance. Fee $25 per course. *Professor Brinsmaid*

MUSIC 531-534. ADVANCED ORGAN (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 31-34. Fee $30 per course. *Professor Ceiga*

MUSIC 558-561. FREE COMPOSITION (3 per course) Composition: vocal and instrumental, standard or modern idioms. Prerequisite: 18 credits in harmony, counterpoint, and piano. *Professor Henninger*

MUSIC 563. FREE ARRANGING (3) Correct procedure in arranging for vocal and instrumental ensembles; practical exercises in quartets, glee clubs, and choruses; small instrumental groups, band, and orchestra. Prerequisite: 18 credits in harmony, including 3 of orchestration. *Professor Fishburn*

MUSIC 567. THE LITERATURE OF THE ORCHESTRA (3) The suite, symphony, tone poem, and overture from the point of view of appreciation, form, and orchestration. Prerequisites: Music 6 and theoretical knowledge of the key instruments of the orchestra. *Professor Fishburn*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MUSIC 407. PIANO REPERTOIRE (3) *Professor Brinsmaid*
MUSIC 408. VOCAL LITERATURE (3) *Mrs. Reynolds*
MUSIC 410. MUSIC OF THE 20TH CENTURY (3)
MUSIC 411. LITERATURE OF THE VIOLIN (3)
MUSIC 429-432. SINGER'S STYLE AND INTERPRETATION (3 per course) Fee $25 per course. *Professor Taylor*
MUSIC 456. ELEMENTARY COUNTERPOINT (3) *Professor Henninger*
MUSIC 466. ADVANCED CONDUCTING (3) *Professor Gullo*

MUSIC EDUCATION

PROFESSOR HUMMEL FISHBURN, M.A., Mus.D.
Head of the Department

MUSIC ED. 500. MUSIC EDUCATION SEMINAR (3-6) Problems of various phases of music education, both instrumental and vocal; research and literature dealing with these problems.

MUSIC ED. 569. PRESENT-DAY TRENDS IN INSTRUMENTAL MUSIC (3) New methods and materials for band, orchestra, and ensembles.

MUSIC ED. 571. VOCAL PEDAGOGY (3) Detailed study of vocal problems met in public schools, elementary through high school; vocal class pedagogy and literature; daily voice training. Prerequisites: Music Ed. 48 and teaching experience.

MUSIC ED. 572. INSTRUMENTAL PEDAGOGY (3-6) Research problems in band and orchestra. Prerequisite: Music Ed. 54 or practical experience.

MUSIC ED. 573. THE MATERIALS OF APPRECIATION (3) Methods and materials for the development of music appreciation in the elementary and secondary schools. Prerequisites: Music 5 and teaching experience.

MUSIC ED. 574a,b. PRESENT-DAY TRENDS IN MUSIC EDUCATION (3-6) Present-day music education materials and methods (elementary and secondary levels) in relation to modern educational philosophy; emphasis upon practical problems presented by members of the class. Prerequisites: Music Ed. 48 and teaching experience.

MUSIC ED. 575. THE JUNIOR HIGH SCHOOL MUSIC CURRICULUM (3) Instructional materials, procedures, curricular and extracurricular activities, integration with other subjects.

MUSIC ED. 576. MUSIC SUPERVISION (3) Current educational procedures in training music supervisors.

MUSIC ED. 580. FIELD PROJECTS IN JUNIOR AND SENIOR HIGH SCHOOL MUSIC (3) Curricular problems to be carried on under actual school conditions; individual work under supervision. Prerequisites: teaching experience and 30 credits of graduate study.

MUSIC ED. 590. THESIS (3-15)

MUSIC ED. 594. PEDAGOGY OF EAR TRAINING (3) Materials and methods for training the listener to grasp, understand, and write what is heard from melody to four-part harmony. Prerequisite: 12 credits in ear training and/or harmony.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

MUSIC ED. 401. MUSIC IN THE RURAL AREA (3)

MUSIC ED. 462. PEDAGOGY OF THEORY (3)

MUSIC ED. 468. THE TEACHING OF PIANO (3)

MUSIC ED. 469. BAND AND ORCHESTRA TECHNIQUE (3)

MUSIC ED. 470. CHORAL TECHNIQUE (3)

MUSIC ED. 475. OBJECTIVES AND PROBLEMS IN ELEMENTARY MUSIC EDUCATION (3)

PETROLEUM AND NATURAL GAS

Professor John C. Calhoun, M.S., Ph.D.
Chief of the Division

Pet.E. 500a. Petroleum and Natural Gas Engineering Research (3-9 per semester)

Pet.E. 501. Energetics of Petroleum Engineering (3) Applications of thermodynamics to special problems in production of petroleum and natural gas. Prerequisite: M.E. 2.

Pet.E. 502a. Petroleum and Natural Gas Engineering Seminar (3-9) An intensive study of one or several phases of petroleum engineering.

Pet.E. 503. The Flow of Homogeneous Fluids Through Porous Media (3) Flow and pressure distributions for various geometric patterns for steady and unsteady states. Prerequisite: Math. 431.

Pet.E. 504. Water Flooding (3-6) Continuation of Pet.E. 485 with emphasis on special problems. Prerequisite: Chem. 40.

Pet.E. 506. Advanced Petroleum Engineering (5) Advanced problems in petroleum and natural gas production. Prerequisites: Chem. 41, Pet.E. 74.

Pet.E. 507. Condensate Fields (2) Retrograde condensation phenomenon of hydrocarbon mixtures at high pressures; literature on condensate fields; production methods and equipment design: casing heads, compressors, separators, stabilizers; safety measures. Prerequisite: Pet.E. 501.

Pet.E. 508. Colloidal Behavior of Industrial Clays, Muds, and Slimes (2-3) Principles of colloidal activity applied to the control of the properties of clay slips, drilling fluids, and similar suspensions. (In co-operation with the Ceramics staff.) Prerequisite: Chem. 41. *Professor Henry*

Pet.E. 509. Advanced Petroleum Engineering Design (2) Continuation of Pet.E. 84. Projects in the selection of engineering materials for casing programs, drilling rigs; production, treatment, stabilization, and transportation of crude oils. Prerequisite: Pet.E. 84.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Pet.E. 481. Natural Gas and Gasoline Plants (4)
Pet.E. 485. Secondary Recovery (3)
Pet.E. 491. Oil and Gas Reservoir Engineering (3)
Pet.E. Lab. 481. Natural Gas Laboratory (1)
Pet.E. Lab. 490. Advanced Core Testing (3)

PHILOSOPHY

Professor John A. Mourant, M.A., Ph.D.
Head of the Department

Phil. 500a,b. Ethical Seminar (2-6) A critical study of some phase of ethical fact and theory.

Phil. 501a,b,c,d. Philosophy Seminar (2-12) Meets the demand for advanced study in special fields of philosophical thought.

Phil. 502. Theory of Epistemology (3) A systematic and critical analysis of some aspect of contemporary epistemology.

Phil. 503. Logic (3) The logical basis of mathematics and its ultimate nature.

Phil. 504. Social and Political Philosophy (3) A critical study of basic problems in their historical and functional setting.

Phil. 505. Ideals of Western Civilization (3) An analysis of contemporary ideals in terms of their Graeco-Judean bases.

Phil. 507. Seminar in History of Philosophy (3-12) Concentrated study of some work or problem in the history of philosophy.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Phil. 401. Religious Philosophy of the Great Reformers (3)
Phil. 405. Philosophy of St. Augustine (3)
Phil. 408. Advanced Social and Political Philosophy (3)
Phil. 409. Philosophy of St. Thomas Aquinas (3)
Phil. 415. The Philosophy of Kant (3)
Phil. 418. Recent and Contemporary Philosophy (3)
Phil. 426. Metaphysics (3)
Phil. 427. Advanced Ethics (3)
Phil. 428. Advanced Logic (3)
Phil. 430. Honors Course in Philosophy (3)

PHYSICAL EDUCATION

Consult Professor Lloyd M. Jones, M.A., Ph.D.

Phys. Ed. 500. Problem in Physical Education (3) Prerequisite: Phys. Ed. 455.

Phys. Ed. 522. Organization and Administration of Physical Education in Colleges and Universities (3) Administration of physical education in college; credits, schedules, excuses, records, reports, budgets, classification, tests, staff, and facilities. Prerequisite: Phys. Ed. 491. *Professor Thiel*

PHYS. ED. 523. ADMINISTRATION OF COLLEGE ATHLETICS (3) Eligibility, schedules, managerial systems, the relationships of athletics to the physical education program and to education in general. Prerequisite: Phys. Ed. 491. *Professor Bedenk*

PHYS. ED. 526. ATHLETIC PROBLEMS IN SCHOOLS (3) Practical problems which result from the administration of athletics in schools. Reports on some aspects of athletics required. Prerequisite: Phys. Ed. 460. *Professor Bedenk*

PHYS. ED. 528. PROFESSIONAL EDUCATION OF TEACHERS OF HEALTH AND PHYSICAL EDUCATION (3) Health and physical education surveys, publicity, sociability and personality tests, legislation, state certification, standards for facilities and equipment, in-service, follow-up, and teacher-community problems. Prerequisite: Phys. Ed. 491. *Professor Jones*

PHYS. ED. 529. SUPERVISION OF PHYSICAL EDUCATION IN SCHOOLS (3) Methods and policies of the school supervisor of physical education; conferences, planning and presenting the program, evaluating results, improving teachers-in-service, supervision of the classroom teacher. Prerequisites: Phys. Ed. 452, 453, 491. *Professor Jones*

PHYS. ED. 530. RESEARCH TECHNIQUES IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Phys. Ed. 490. *Professor Lawther*

PHYS. ED. 531. RESEARCH IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Phys. Ed. 530. *Professor Masley*

PHYS. ED. 532. TESTS AND MEASUREMENTS IN PHYSICAL EDUCATION (3) Critical study of the tests and measurements available in physical education; methods of constructing and evaluating new tests and measurements. Prerequisite: Phys. Ed. 490. *Professor Masley*

PHYS. ED. 534. STUDIES IN CURRICULUM CONSTRUCTION IN PHYSICAL EDUCATION (3) Principles and methods of curriculum building in physical education; the different psychological and educational points of view, organizing a course of study committee, making units of instruction. Prerequisites: Phys. Ed. 452, 453, 454. *Professor Jones*

PHYS. ED. 535. MODERN FOREIGN SYSTEMS OF PHYSICAL EDUCATION (3) Comparative analysis of national and local programs and systems of physical education in foreign countries. Prerequisites: Phys. Ed. 534, 595. *Professor Speidel*

PHYS. ED. 536. SCIENTIFIC METHODS IN ATHLETIC COACHING (3) Unusual techniques in athletic coaching which are not commonly recognized and used; advanced skills and strategy in coaching major sports. Prerequisite: Phys. Ed. 460. *Professor Lawther*

PHYS. ED. 550. SEMINAR IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (1-6) Open only to students preparing approved theses and dissertations. *Professor Jones and Staff*

PHYS. ED. 555. RELATIONSHIPS OF PHYSICAL EDUCATION TO THE EXACT SCIENCES (3) *Professor Lucey*

PHYS. ED. 560. ADMINISTRATIVE PROBLEMS OF PHYSICAL EDUCATION IN SCHOOLS (3) Solutions to problems emerging from the administration of physical education

in schools, fitting physical education into the school's schedule, awards and budgets. Prerequisite: Phys. Ed. 491. *Professor Jones*

PHYS. ED. 581. PROBLEMS IN BODY MECHANICS (3) Certain aspects of human motion and body segmental alignment; analysis of human gait, and the dynamic adaptation of the spine, thorax, and pelvis to external physical forces. Prerequisites: Health Ed. 244, Phys. Ed. 399. *Professor Kelly*

PHYS. ED. 595. PHILOSOPHY OF HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Health Ed. 453 or Phys. Ed. 491 or Rec. 465. *Professor Jones*

PHYS. ED. 598. THESIS (1-6)

PHYS. ED. 599. DISSERTATION (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PHYS. ED. 424. MODERN TRENDS IN HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS (3) *Professor Jones*
PHYS. ED. 429S. THE MODERN DANCE IN EDUCATION (3) *Professor Briant*
PHYS. ED. 431S. COACHING OF ADVANCED BASEBALL (3) *Professor Bedenk*
PHYS. ED. 436S. COACHING OF ADVANCED FOOTBALL (3) *Professor Bedenk*
PHYS. ED. 437S. COACHING OF ADVANCED BASKETBALL (3) *Professor Gross*
PHYS. ED. 438S. COACHING OF ADVANCED TRACK (3) *Professor Werner*
PHYS. ED. 439S. COACHING OF ADVANCED SOCCER (3) *Mr. Jeffrey*
PHYS. ED. 440S. COACHING OF ADVANCED GYMNASTICS (3) *Professor Wettstone*
PHYS. ED. 441S. ADVANCED COACHING OF ATHLETICS FOR MEN (1-11)
Unit A. Basketball (1) *Professor Gross*
Unit B. Football (1) *Professor Bedenk*
Unit C. Track and Field (1) *Professor Werner*
Unit D. Baseball (1) *Professor Bedenk*
Unit E. Wrestling (1) *Professor Speidel*
Unit F. Soccer (1) *Mr. Jeffrey*
Unit G. Swimming (1) *Mr. Gutteron*
Unit H. Gymnastics (1) *Professor Wettstone*
Unit I. Boxing (1) *Mr. Sulkowski*
Unit J. Lacrosse (1) *Professor Thiel*
Unit K. Fencing (1) *Professor Meyer*
PHYS. ED. 449S. ADVANCED TEACHING OF SPORTS AND RHYTHMICS (1-11)
Unit A. Soccer and Speedball (1) *Professor Lucey*
Unit B. Basketball (1) *Professor Lucey*
Unit C. Field Hockey (1) *Professor Lucey*
Unit D. Archery (1) *Professor Haidt*
Unit E. Swimming (1)
Unit F. Rhythmics for Children (1) *Professor Briant*
Unit G. Modern Dance and Accompaniment (1) *Professor Briant*
Unit H. Early American Country Dancing and Social Dancing (1) *Professor Briant*

Unit I. Tennis (1) *Professor Lucey*
Unit J. Badminton (1) *Professor Lucey*
Unit K. Golf (1) *Mr. Rutherford*

PHYS. ED. 452S, 452X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE ELEMENTARY SCHOOL (3) *Professor Speidel*

PHYS. ED. 453S, 453X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE HIGH SCHOOL (3) *Professor Bischoff*

PHYS. ED. 454. THE NATURAL PROGRAM OF PHYSICAL EDUCATION ACTIVITIES, APPLIED (3) *Professor Bischoff*

PHYS. ED. 455. SCIENTIFIC METHOD IN HEALTH AND PHYSICAL EDUCATION (3) *Professor Masley*

PHYS. ED. 460. METHODS AND PRINCIPLES OF ATHLETIC COACHING (3) *Professor Lawther*

PHYS. ED. 466S. VISUAL INSTRUCTION IN ATHLETICS (3) *Professor Conger*

PHYS. ED. 471S. HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS FOR THE SCHOOL ADMINISTRATOR (3) *Professor Jones*

Unit A. Athletics in the Schools (1)
Unit B. Health Education in the Schools (1)
Unit C. Physical Education and Recreation in the Schools (1)

PHYS. ED. 480. ADVANCED ANATOMY AND PHYSIOLOGY, APPLIED (3) *Professor Kelly*

PHYS. ED. 482, 482X. POSTURE EDUCATION IN THE SCHOOLS (3) *Professor Kelly*

PHYS. ED. 488S. THE ADMINISTRATION OF PHYSICAL EDUCATION AND ATHLETICS FOR WOMEN (3) *Professor Haidt*

PHYS. ED. 489. INTRAMURAL ATHLETICS (3) *Professor Bischoff*

PHYS. ED. 490. INTRODUCTION TO TESTS AND MEASUREMENTS IN HEALTH AND PHYSICAL EDUCATION (3) *Professor Masley*

PHYS. ED. 491. ORGANIZATION AND ADMINISTRATION OF HEALTH AND PHYSICAL EDUCATION IN SCHOOLS (3) *Professor Jones*

PHYSICS

PROFESSOR D. C. DUNCAN, M.A., Ph.D.
Acting Head of the Department

PHYS. 501a,b,c,d,e. PHYSICS RESEARCH (1-15 per semester) Original work to obtain material for a thesis. May be continued in successive semesters as Phys. 501b, 501c, etc. to a maximum of 45 credits.

PHYS. 507. THEORETICAL THERMODYNAMICS (3) A mathematical treatment of the principles of thermodynamics.

PHYS. 509. PHYSICS SEMINAR (1) Selected topics from current physical research critically examined and discussed. May be continued in successive semesters as Phys. 509a, 509b, 509c.

PHYS. 517. KINETIC THEORY (3) The Maxwell-Boltzmann law, Brownian movements, specific heats, and other selected topics. Prerequisites: Phys. 411, Math. 431.

PHYS. 521. CRYSTAL STRUCTURE (3) The solution of the structure of crystals by X-ray methods. Available for major credit in either physics or chemistry.

PHYS. 522. ADVANCED CRYSTAL ANALYSIS (3) Continuation of Phys. 521, including the application of crystal structure studies to physical, chemical, and metallurgical problems. Available for major credit in either physics or chemistry.

PHYS. 530. INTRODUCTION TO THEORETICAL PHYSICS (3) The application of higher mathematics to problems in the various fields of physics. Prerequisites: Math. 431, Phys. 285.

PHYS. 531. THEORETICAL PHYSICS (3) Continuation of Phys. 530.

PHYS. 533. THEORY OF SOUND (3) Mathematical treatment of the theory of sound. Prerequisite: Phys. 530.

PHYS. 553. NUCLEAR PHYSICS (3) Mathematical course in nuclear physics. Prerequisite: Phys. 562.

PHYS. 557. ELECTRICITY AND MAGNETISM (3) Treatment of the mathematical theory of electricity and magnetism. Prerequisite: Phys. 467.

PHYS. 558. ELECTRICITY AND MAGNETISM (3) Continuation of Phys. 557. Prerequisite: Phys. 557.

PHYS. 560. ADVANCED PHYSICAL MEASUREMENTS (1-18) Offers opportunity for advanced work in the various fields of physics.

PHYS. 561. DE BROGLIE WAVES AND QUANTUM MECHANICS (3) An introduction to the modern interpretation of atomic structure and radiation phenomena, based upon the de Broglie and Schroedinger wave theory. Prerequisite: Phys. 531.

PHYS. 562. WAVE MECHANICS IN MODERN PHYSICS (3) This continuation of Phys. 561 discusses the theory of atomic and simple molecular spectra, Zeeman and Stark effect, theories of metallic conductivity and thermionic emission, etc. Prerequisite: Phys. 561.

PHYS. 571. ATOMIC STRUCTURE (3) Recent work in atomic and subatomic physics.

PHYS. 572. SPECTROSCOPY (3) Atomic and molecular spectra, both emission and absorption methods of excitation, radiation and ionization potentials, spectral series, fine structure, spectra of ionized and stripped atoms.

PHYS. 575. PROBLEMS IN MODERN PHYSICS (1-3) Theoretical studies in any field of modern physics with or without associated experimental work. Prerequisite: Phys. 456.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PHYS. 400. INTERMEDIATE ELECTRICITY AND MAGNETISM (4)

PHYS. 402. ELECTRONICS (4)
PHYS. 404. ELECTRONIC MEASUREMENTS (2-4)
PHYS. 411. THEORETICAL MECHANICS (3)
PHYS. 417. THE TEACHING OF PHYSICS (3)
PHYS. 420. INTERMEDIATE HEAT (3)
PHYS. 433S. INTERMEDIATE MECHANICS AND FLUID PHYSICS (3)
PHYS. 435S. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
PHYS. 437S. INTERMEDIATE HEAT, SOUND, AND LIGHT (3)
PHYS. 439S. ELEMENTARY SURVEY OF MODERN PHYSICS (3)
PHYS. 443. INTERMEDIATE ACOUSTICS (3)
PHYS. 444. MEASUREMENTS IN ACOUSTICS (2)
PHYS. 454, 454X. ATOMIC AND NUCLEAR PHYSICS (3)
PHYS. 456. ATOMIC AND NUCLEAR PHYSICS (3)
PHYS. 457. EXPERIMENTAL ATOMIC PHYSICS (2)
PHYS. 458. INTERMEDIATE OPTICS (4)
PHYS. 461. THEORETICAL MECHANICS (3)
PHYS. 467. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
PHYS. 477. X-RAY ANALYSIS OF SOLIDS AND LIQUIDS (3)
PHYS. 486. ASTRONOMICAL PHOTOGRAPHY (3-6)
PHYS. 490. MODERN STELLAR THEORY (3-9)
PHYS. 491S. ADVANCED CELESTIAL MEASUREMENTS (3-9)

POLITICAL SCIENCE

PROFESSOR R. WALLACE BREWSTER, M.A., Ph.D.
Head of the Department

POL. SCI. 500. SEMINAR IN POLITICAL SCIENCE (3-12) Subject to be announced.
POL. SCI. 505. SEMINAR IN ADVANCED AMERICAN GOVERNMENT (3-12)
POL. SCI. 508. RESEARCH IN PUBLIC ADMINISTRATION (3-12)
POL. SCI. 509. RESEARCH TECHNIQUES IN POLITICAL SCIENCE (3)
POL. SCI. 510. POLITICAL AND ADMINISTRATIVE PROBLEMS IN PENNSYLVANIA (3-6)
POL. SCI. 512. COMPARATIVE GOVERNMENT (3-12)
POL. SCI. 515. INTERNATIONAL RELATIONS (3-6)
POL. SCI. 517. INTERNATIONAL ORGANIZATION (3-6)
POL. SCI. 519. PUBLIC ADMINISTRATION (3-6)
POL. SCI. 521. POLITICAL THEORY (3-6)
POL. SCI. 535. GOVERNMENT REGULATION (3-6)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

POL. SCI. 411. AMERICAN POLITICAL THEORY (3)
POL. SCI. 413. GOVERNMENT AND FOREIGN POLICY OF THE SOVIET UNION (3)
POL. SCI. 415. INTERNATIONAL ORGANIZATION (3)
POL. SCI. 416. INTERNATIONAL LAW (3)

Pol. Sci. 417. Municipal Government (3)
Pol. Sci. 419. Public Administration (3)
Pol. Sci. 421. Modern Political Theories (3)
Pol. Sci. 427. Public Opinion and Propaganda (3)
Pol. Sci. 428. Pennsylvania Local Government (3)
Pol. Sci. 429. Pennsylvania Local Administration (3)
Pol. Sci. 431. Ancient and Medieval Political Theories (3)
Pol. Sci. 432. Current Political Trends and Problems in the United States (3-9)
Pol. Sci. 433. Labor and Welfare Legislation and Administrative Problems (3)
Pol. Sci. 435. Government Housing, Planning, and Public Works (3)
Pol. Sci. 442. American Foreign Policy (3)
Pol. Sci. 444. Government Regulation (3)
Pol. Sci. 445. Administrative Law (3)
Pol. Sci. 446. Judicial Systems (3)
Pol. Sci. 456. Governments and Foreign Policies of Latin America (3)
Pol. Sci. 458. Governments and Foreign Policies of the Far East (3)
Pol. Sci. 499X. Foreign Study in Government (2-6)

PORTUGUESE

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

Port. 571. Seminar in Portuguese Literature (3-6) Prerequisite: Port. 4.

POULTRY HUSBANDRY

Professor Ernest W. Callenbach, M.S.
Head of the Department

P.H. 502. Advanced Poultry Nutrition (2-4) Prerequisite: P.H. 3.
Professor Murphy

P.H. 503. Advanced Poultry Farm Management (2-4) Prerequisite: P.H. 8.
Professor Bressler

P.H. 504. Advanced Market Poultry and Eggs (2-4) Prerequisites: P.H. 1, 7; Agr. Ec. 33 or 2 additional credits in poultry husbandry. *Professor Margolf*

P.H. 505. Research in Poultry Husbandry (3-10) Prerequisite: 9 credits in poultry husbandry. *Professor Callenbach and Staff*

P.H. 506. Seminar in Poultry Husbandry (1-6)
Professor Callenbach and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

P.H. 412. Poultry Breeding (3) *Professor Maw*

PSYCHOLOGY

Professor Bruce V. Moore, M.A., Ph.D.
Head of the Department

Psy. 500. Seminar: Introduction to Research Methods (1) Prerequisite: 12 credits in psychology.

Psy. 501. Advanced Psychology (3) A comprehensive study of general psychology. Prerequisite: 9 credits in psychology. *Professor Lepley*

Psy. 502. Advanced Educational Psychology (2-4) Psychological theories and principles underlying educational theories and practices. Prerequisites: Psy. 14 or 414; Ed. 31 or teaching experience. *Professor van Ormer*

Psy. 503. Physiological Psychology (2-6) Correlations between structure and function of nervous system and human consciousness; laws and theories in fields of sensation, attention, association, affection, and thought. Prerequisite: 9 credits in psychology. *Professor DeCamp*

Psy. 504. Comparative Psychology (2-4) Behavior from standpoint of phylogenetic growth and development; biological implications; comparison of different types of animals, including man. Prerequisite: 9 credits in psychology. *Professor Carpenter*

Psy. 505. Research Problems in Psychology (1-15) Prerequisite: 12 credits in psychology.

Psy. 506. Clinical Psychology (1-6) Procedures used in the Psychology Clinic. Limited to students enrolled in Psy. 560. Prerequisites: Ed. 70 or Psy. 471; Psy. 550 or 551. *Professor Snyder*

Psy. 509. Advanced Theory of Learning and Habit Formation (2-3) Critical evaluation of the major theories of learning: Hull, Guthrie, Tolman, Lewin. Application of learning theory to major problems in psychology. Prerequisite: Psy. 4 or 407 or 414. *Professor Grosslight*

Psy. 510. History of Psychology (3) The theoretical systems, experiments, and personalities in the development of modern psychology until about 1920. Prerequisite: 9 credits in psychology. *Professor Carpenter*

Psy. 511. Contemporary American Psychology (2-3) Current systems or schools of psychology with comparative study and critical analysis; points of view as presented by recognized leaders. Prerequisite: 9 credits in psychology. *Professor Lepley*

PSY. 513. EDUCATIONAL PSYCHOLOGY: DIFFERENTIAL (2) Causes of differences in achievement and personality; psychological implications of the methods used by schools in adjusting to individual differences. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor van Ormer*

PSY. 514. EDUCATIONAL PSYCHOLOGY: LEARNING (2) Experimentally determined facts about the learning process; synthesis of main theories of learning; application of principles related to: motivation, practice, retention, transfer, meaning, and problem solving. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor van Ormer*

PSY. 515. ADVANCED STATISTICS IN PSYCHOLOGY AND EDUCATION (3) Sampling, tests of significance, factor analysis, analysis of variance and other advanced statistical methods; the application of statistical methods to practical problems. Prerequisite: Psy. 415 or Ed. 574. *Professor Kurtz*

PSY. 517. PSYCHOLOGY OF ATTITUDES AND OPINIONS (3) Acquisition and control of attitudes and opinions, including beliefs, convictions, biases, prejudices, and ideologies as determinants of action. Prerequisite: 18 hours in psychology, including Psy. 417, 422, 437. *Professor Carpenter*

PSY. 518. PROJECTS IN EXPERIMENTAL PSYCHOLOGY (2-4) Individual experimental projects; seminars on experimental design and instrumentation. Prerequisite: Psy. 407.

PSY. 521. RESEARCH PROBLEMS IN INDUSTRIAL PSYCHOLOGY (2-6) Actual industrial personnel problems in laboratory and industrial plants: monotony, fatigue, psychological selection, and training procedures. Prerequisites: Psy. 21, 431. *Professor Kinsley Smith*

PSY. 522. ADVANCED PSYCHOLOGICAL MARKETING RESEARCH TECHNIQUES (3) Current literature; special questionnaire designs to test consumer reaction to products, advertising, and company policies from psychological standpoint; scale analysis; consumer motivation. Prerequisite: 15 credits in psychology, including Psy. 15, 21, 422. *Professor Guest*

PSY. 525. SAMPLING DESIGNS IN MARKET AND OPINION RESEARCH (3) Techniques in the selection of samples for accurate representation of human populations; special emphasis given to probability sampling. Prerequisites: Psy. 15, 21, 422.

PSY. 526. ANALYSIS AND PRESENTATION OF MARKET AND OPINION RESEARCH DATA (3) Classification and cross-tabulation of data as an aid in understanding research; analysis of opinion data by punch-card equipment. Prerequisites: Psy. 15, 21, 422.

PSY. 528. OPINION RESEARCH ADMINISTRATION (3-6) Practicum in the planning, development of techniques, and administration of the sample survey. Prerequisite: Psy. 428. *Professor Guest*

PSY. 534. APPLICATIONS OF PSYCHOLOGY IN BIO-MECHANICS (2) Experimental studies of psychological factors affecting design and operation of machines. Prerequisites: Psy. 3 and 4, or 501. *Professor Kinsley Smith*

Psy. 539. Motivation and Emotion (3) Systematic status of instinct, drive, motive, will, purpose; methodology and results of physiological, experimental, and clinical investigation of basic drives. Prerequisites: Psy. 3, 4.
Professor Kendon Smith

Psy. 540. Clinical Psychology Seminar (1-6) Seminar on current problems in clinical psychology. Prerequisite: Psy. 482.

Psy. 541. Dynamics of Human Adjustment (3) Seminar on motivation of human behavior, frustration, and mechanisms of adjustment; normal behavior is stressed. Prerequisite: Psy. 437. *Professor Bernreuter*

Psy. 542. Psychopathology (3) Covers basic, developmental, human, experimental reactions, showing how normal and pathological character trends and deviations evolve; basic reasons for and applications of psychotherapeutic methods. Prerequisite: Psy. 412 or 437. *Professor Lott*

Psy. 543. Counseling Techniques (2) Survey of psychotherapeutic methods; history, theory, and methods employed; case illustrations. Prerequisite: Psy. 482.
Professor Snyder

Psy. 550. Psychometrics: Binet (2) Measurement of intelligence by Stanford revision of the Binet-Simon technique; demonstrations, lectures; practice administering tests; observations of student by instructor. Prerequisite: Psy. 471.

Psy. 551. Psychometrics: Point Scales (2) Measurement of intelligence by individual nonverbal techniques: Arthur, Wechsler-Bellevue, and others; demonstrations, lectures, and practice administering tests under observation. Prerequisite: Psy. 471.

Psy. 552. Psychometrics: Preschool (2) Measurement by individual preschool scales: Merrill-Palmer, Minnesota, California First Year; demonstrations, lectures, and practice in administering tests under observation. Prerequisite: Psy. 551.

Psy. 553. Psychometrics: Advanced (2) Measurement of intelligence, social maturity, and other characteristics; demonstration, lectures, and practice in administering tests; observations by instructor. Prerequisite: Psy. 550.
Professor Bernreuter

Psy. 554. Psychometrics: Sensory (2-3) Measurement of auditory and visual acuity and defects; psychophysiological theory; demonstrations, lectures, and practice in administering and interpreting tests under observation. Prerequisite: Psy. 4.

Psy. 555. Psychometrics: Rorschach Administration (3) Introduction to theory of projective tests; supervised practice in administering and scoring of the Rorschach test. Prerequisite: Psy. 550 or 551. *Professor Guthrie*

Psy. 556. Psychometrics: Rorschach Interpretation (3) Study of current literature and supervised practice. Prerequisite: Psy. 555. *Professor Guthrie*

Psy. 557. Psychometrics: Advanced Projective Techniques (2-3) Survey of

common projective techniques other than the Rorschach, with supervised practice. Prerequisite: Psy. 556. *Professor Guthrie*

Psy. 560. Clinical Practicum (2-3) Applied experience in techniques of clinical psychology; case work in Psychology Clinic. Prerequisites: Psy. 482, 550, 551.

Psy. 561. Clinical Practicum: Elementary School (1-3) Experience in the Psychology Clinic and public schools in learning and adjustment problems; diagnosis and remedial work; pertinent school laws and practices. Prerequisites: Psy. 560 and Ed. 70, or Ed. 432g or 470.

Psy. 562. Clinical Practicum: Vocational Guidance (1-3) Practical experience in the Psychology Clinic on high school, college, and adult vocational guidance cases; staff meetings; seminar on techniques and materials. Prerequisite: Psy. 560 or Ed. 502.

Psy. 563. Clinical Practicum: Marital Counseling (1-3) Experience in the Psychology Clinic on premarital and marital adjustment; seminar on techniques of adjustment and development of sexual and emotional maturity in marriage. Prerequisite: Psy. 560. *Professor Adams*

Psy. 564. Clinical Practicum: Personal Adjustment Counseling (2-3) Advanced practicum with experience in counseling of personal adjustment problems referred to the Psychology Clinic. Prerequisite: Psy. 565. *Professor Snyder*

Psy. 565. Clinical Practicum: Nondirective Counseling (3) Practical experience in application of the nondirective method, along with systematic theoretical study of the method. Prerequisites: Psy. 543, 560. *Professor Snyder*

Psy. 566. Clinical Practicum: Hypnotherapy (1-3) Practical experience in the Psychology Clinic in the use of hypnotherapy; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

Psy. 567. Clinical Practicum: Play Therapy (1-3) Practical experience in the Psychology Clinic in the use of play therapy with young children; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

Psy. 568. Clinical Practicum: Group Therapy (2) Practical experience in the Psychology Clinic in the use of group methods for the treatment of personal maladjustments; staff meetings; seminar on principles and techniques. Prerequisite: Psy. 565.

Psy. 569. Clinical Practicum: Advanced Nondirective (2) Practical experience in the Psychology Clinic in advanced nondirective therapy techniques; staff meetings; case conferences. Prerequisite: Psy. 565.

Psy. 574. Mental Deficiency (3) Causes of mental deficiency; diagnosis, training, and care of mental defectives. Prerequisites: Psy. 414 or 482.

Psy. 590. Seminar: Advanced (1-2) Prerequisite: Psy. 500.

Psy. 591. Seminar on Teaching Psychology (1-3) Objectives and content of psychology; organization and presentation of material; teaching aids and techniques. Prerequisites: Psy. 407 or 501; 510 or 511.

PSY. 599. THESIS (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

PSY. 400. HONORS COURSE IN PSYCHOLOGY (2-6)
PSY. 407. INTERMEDIATE EXPERIMENTAL PSYCHOLOGY (3) *Professor Lepley*
PSY. 411, 411X. PSYCHOLOGY OF THE PRESCHOOL CHILD (3) *Professors van Ormer and Thevaos*
PSY. 412, 412X. ABNORMAL PSYCHOLOGY (3) *Professor DeCamp*
PSY. 414, 414X. INTERMEDIATE EDUCATIONAL PSYCHOLOGY (2-3)
PSY. 415, 415X. INTERMEDIATE STATISTICS IN PSYCHOLOGY AND EDUCATION (3) *Professor Kurtz*
PSY. 417. SOCIAL PSYCHOLOGY (2-3) *Professor Carpenter*
PSY. 418. MEASUREMENT OF PERSONALITY (2-3) *Professor Bernreuter*
PSY. 419. GUIDANCE AND EDUCATION IN SEXUAL AND MARITAL ADJUSTMENT (3) *Professor Adams*
PSY. 420. APPLIED SOCIAL PSYCHOLOGY (3) *Professors Carpenter and Kinsley Smith*
PSY. 422. PSYCHOLOGICAL METHODS OF MEASURING THE REACTIONS OF THE PUBLIC (3) *Professor Guest*
PSY. 423. TEST CONSTRUCTION AND STANDARDIZATION (2-3) *Professor Kurtz*
PSY. 424, 424X. PSYCHOLOGICAL TECHNIQUES IN PUBLIC PERSONNEL ADMINISTRATION (3) *Professor Adams*
PSY. 425, 425X. PSYCHOLOGY OF THE ELEMENTARY SCHOOL CHILD (2-3) *Professor van Ormer*
PSY. 426, 426X. ADOLESCENCE (2-3) *Professors van Ormer and Thevaos*
PSY. 427. PSYCHOLOGICAL PRINCIPLES IN ADVERTISING (3) *Professor Guest*
PSY. 428. OPINION RESEARCH LABORATORY (3) *Professor Guest*
PSY. 429. PSYCHOLOGY OF COMMUNICATION (3)
PSY. 431, 431X. INDUSTRIAL PSYCHOLOGY (3) *Professor Kinsley Smith*
PSY. 437, 437X. PSYCHOLOGY OF ADJUSTMENT (3)
PSY. 438. THEORY OF PERSONALITY (3) *Professor Grosslight*
PSY. 440. PSYCHOLOGY PROJECTS (1-6)
PSY. 471, 471X. MEASUREMENT OF INTELLIGENCE (2) *Professor Bernreuter*
PSY. 472. SPECIAL ABILITY TESTING (2) *Professor Moore*
PSY. 482. INTRODUCTION TO CLINICAL PSYCHOLOGY (3) *Professor Snyder*
PSY. 495S. FAMILY HEALTH AND HUMAN RELATIONS (3-9)

PUBLIC UTILITIES

PROFESSOR ARTHUR H. WAYNICK, B.S., M.S., SC.D.
Head of the Department of Electrical Engineering

PUB. UTIL. 521. PUBLIC UTILITIES (3) Problems of current interest in the public utility field, principally those utilities involving the use of the principles of electrical engineering. *Professor Powell*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

PUB. UTIL. 421. ELECTRIC UTILITIES (3) *Professor Powell*

RECREATION

Consult PROFESSOR FRED M. COOMBS, M.A.

REC. 530. CAMP ADMINISTRATION (3) Camp site development; staff selection, training, and supervision; development of objectives and program planning; the values inherent in outdoor and camping education. Prerequisite: Rec. 430.

REC. 533. RECREATION STUDIES, SURVEYS, AND APPRAISALS (3) Types, purposes, and methods of conducting recreation studies and surveys; procedures in the appraisal of community recreation. Prerequisite: Phys. Ed. 530. *Professor Coombs*

REC. 560. ADMINISTRATIVE PROBLEMS OF RECREATION (3) Administrative problems in park and recreation departments; departmental organization, finance, personnel, facilities, program, and public relations. Prerequisite: Rec. 465. *Professor Coombs*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

REC. 430. CAMP COUNSELING (3) *Professor Coombs*
REC. 432. RECREATION IN INDUSTRY (3)
REC. 434. RECREATION AREAS AND FACILITIES (3) *Professor Coombs*
REC. 456. SOCIAL RECREATION (3)
REC. 461, 461X. PROGRAMS OF COMMUNITY RECREATION (1 per unit) *Professor Coombs*
Unit A. Programs of the Rural Community (1)
Unit B. Programs of the Urban Community (1)
Unit C. Programs of Large Muncipalities (1)
REC. 462. RECREATION FOR THE HANDICAPPED (3) *Professor Speidel*
REC. 465, 465X. ADMINISTRATION OF RECREATION (3) *Professor Coombs*

*RURAL SOCIOLOGY

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.
Head of the Department of Agricultural Economics and Rural Sociology

RUR. SOC. 551. RURAL SOCIOLOGY SEMINAR (1-6) Prerequisite: 6 credits in rural sociology, sociology, or psychology.

* Credit in rural sociology will also be given for Agr. Ec. 505 and 525.

RUR. SOC. 552. THE STRUCTURE OF RURAL SOCIETY (3) Systematic review of research dealing with the structure of rural society; the purpose, methodology, and contribution of each study treated. Prerequisites: Rur. Soc. 11, Soc. 1.
Professor John

RUR. SOC. 553. RURAL SOCIAL PROCESSES (3) Continuation of Rur. Soc. 552. The functioning of rural society; research dealing with the subject reviewed and evaluated. Prerequisite: Rur. Soc. 552.

RUR. SOC. 554. ADVANCED RURAL SOCIAL WELFARE (3) Analysis of welfare techniques and their application to rural situations. Prerequisites: Rur. Soc. 11; Psy. 2 or Rur. Soc. 459. *Professor Mather*

RUR. SOC. 555. THE RURAL CHURCH (3) The rural church as a social institution; its relation to the community; the church in "problem" areas; effects of population trends on the program of the rural church; the use of case studies and surveys. Prerequisite: 6 credits in rural sociology, sociology, or psychology. *Professor Mather*

RUR. SOC. 556. THESIS IN RURAL SOCIOLOGY (6) A preparation of the required thesis for the degree of Master of Science in rural sociology while in residence at the College.

RUR. SOC. 557. THE DEVELOPMENT OF THE RURAL COMMUNITY (3) The origin and evolution of the rural community under different geographic and cultural conditions. Prerequisites: Rur. Soc. 11 or Soc. 1; Rur. Soc. 452 or Soc. 415a.
Professor Mather

RUR. SOC. 559. ADVANCED RURAL SOCIAL PSYCHOLOGY (3) The application of social psychological principles to the treatment of rural problems. Prerequisites: Rur. Soc. 11, Psy. 2. *Professor Green*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

RUR. SOC. 452. RURAL ORGANIZATION (3) *Professor Brown*
RUR. SOC. 454. RURAL SOCIAL WELFARE (3) *Professor Mather*
RUR. SOC. 456. RURAL STANDARDS OF LIVING (3) *Professor Mather*
RUR. SOC. 459. RURAL SOCIAL PSYCHOLOGY (3) *Professor Green*

SOCIOLOGY

PROFESSOR SETH W. RUSSELL, M.A., Ph.D.
Head of the Department

SOC. 503. SEMINAR IN SOCIAL PSYCHOLOGY (3-9) Investigation of the theories, methods, and empirical data of social psychology, with particular reference to such problems as the relations between personality and culture, social and personal disorganization, the development of role behavior, and the conception of the self.
Professor Coutu

Soc. 510. Field Work in Sociology (1-3) Advanced research projects to be carried out in the field under the supervision of the department and recognized social agencies.

Soc. 512. Seminar in Modern Criminology (3) Critical analysis of research in criminology and penology. *Professor Clark*

Soc. 513. Advanced Sociological Research Methods and Techniques (3) Special problems in scientific method and research technique; designed to prepare the student for social inquiry on a professional level; embraces both quantitative and nonquantitative types of work. Prerequisites: Soc. 413 and 3 credits of statistics. *Professor John*

Soc. 515. Structure and Functions of the Community (3) *Professor Bernard*

Soc. 516. Sociological Theory (3) *Professor Green*

Soc. 523. Advanced Research in Population (3) Supervised original research on some aspect of demographic phenomena and vital statistics; a genuine contribution to knowledge is expected of the student. *Professor Blizzard*

Soc. 525. Seminar in Sociology (1-9) Research problems in theoretical and applied sociology.

Soc. 530. Research on Marriage and the Family (3) Training in methods and techniques of research in family relations. Under the guidance of the instructor, experimental, statistical, and comparative studies are carried out, individually or cooperatively. Prerequisites: graduate standing and 3 hours' previous work in this field. *Professor Bernard*

Soc. 540. Theory and Method in Anthropology (3) Theory and method used in culture-historical, sociological, and psychological interpretations. *Professor Mook*

Soc. 545. Seminar in Anthropology (1-9) Critical analysis of research in selected areas of regional ethnography and ethnological theory. Prerequisites: Soc. 45, 445. *Professor Mook*

Soc. 561. Seminar in Sociology of Religion (3) Prerequisites: Soc. 60 or 61; 415a or 418; 400 or 401. *Professor Russell*

Soc. 572. Methods of Sampling (3) Application of sampling techniques to sociological research. Prerequisite: Soc. 471. *Professor Clark*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Soc. 400. Sociological Theory (3) *Professor Green*
Soc. 401. Social Institutions (3) *Professor Green*
Soc. 403a. Advanced Social Psychology (3) *Professor Coutu*
Soc. 403b. Advanced Social Psychology (3) *Professor Coutu*
Soc. 405S. Social Problems (3)
Soc. 408. Social Ecology (3) *Professor Blizzard*
Soc. 413. Methods and Techniques of Social Research (1-6) *Professor Bernard*

Soc. 415a.	Community Institutions (3)	*Professor Bernard*
Soc. 418.	The Development of Social Thought (3)	
Soc. 423.	Population Research (3)	*Professor Blizzard*
Soc. 424.	Social Change (3)	*Professor Abramson*
Soc. 425.	Contemporary Sociological Theory (3)	*Professor Green*
Soc. 426.	Introduction to Public Welfare (3)	*Professor Mather*
Soc. 427S.	Family Case Work (6)	
Soc. 429.	Social Stratification (3)	
Soc. 431.	Communication and Mass Society (3)	*Professor Abramson*
Soc. 441.	Folk Society (3)	*Professor Mook*
Soc. 442.	Anthropology of the New World (3)	*Professor Mook*
Soc. 443.	Anthropology of the Old World (3)	*Professor Mook*
Soc. 445.	Primitive Society (3)	*Professor Mook*
Soc. 461.	Sociology of Religion (3)	*Professor Russell*
Soc. 470.	The Use of Statistics in Sociology (3)	*Professor Clark*
Soc. 471.	Advanced Sociological Statistics (3)	*Professor Clark*
Soc. 495S.	Family Health and Human Relations (3)	
Soc. 499X.	Foreign Study in Sociology (2-6)	

SPANISH

Professor Robert J. Clements, M.A., Ph.D.
Head of the Department of Romance Languages

Sp. 544. Neoclassicism in the Romance Literatures (3) The nature and development of the Neoclassic movement in Italy, France, Spain, and Portugal.

Sp. 545. Romanticism in the Romance Literatures (3) The nature and development of the Romantic movement in Italy, France, Spain, and Portugal.

Sp. 546. Medieval Romance Literatures (3) The nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal.

Sp. 547. Realism, with Particular Reference to Romance Literature (3)

Sp. 548. 20th Century Romance Literature as a Political Force (3)

Sp. 551. Romance Philology (3) Historical development of the Romance languages.

Sp. 552. Old Spanish Readings (3) Familiarizes the student with Old Spanish texts.

Sp. 561. Spanish Drama Previous to Lope de Vega (3) Origin and early development of the Spanish national drama. Representative plays of different types will be read and discussed.

Sp. 562. Spanish Drama Previous to Lope de Vega (3) Continuation of Sp. 561.

Sp. 565. Lope de Vega (3)

Sp. 566. Lope de Vega's Followers (3)

Sp. 567. Cervantes and His Works (3)

Sp. 568. Cervantes and His Works (3)

Sp. 571. Seminar in Spanish Literature (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

Sp. 572. Seminar in Spanish Literature (3) Continuation of Sp. 571.

Sp. 574. Methods and Bibliography in Romance Languages and Literatures (1-2)

Sp. 599. Dissertation (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

Sp. 401. The Golden Age (3)
Sp. 402. Drama of the Golden Age (3)
Sp. 403. Don Quixote (3)
Sp. 404. Old Spanish Language and Literature (3)
Sp. 405. Spanish Drama of the 19th Century (3)
Sp. 406. Contemporary Spanish Drama (3)
Sp. 407. The Spanish Novel of the 19th Century (3)
Sp. 408. The Contemporary Spanish Novel (3)
Sp. 409, 409X. Introduction to Latin-American Literature (3)
Sp. 410. Introduction to Latin-American Literature (3)
Sp. 411. Mexico: Its Language and Literature (3)
Sp. 412. Argentina: Its Language and Literature (3)
Sp. 415. Modern Spanish Lyric Poetry (3)
Sp. 417. Spanish Literature in the Romantic Period (3)
Sp. 421. The Teaching of Romance Languages (3)
Sp. 471. Problems in Spanish Literature (3-6)
Sp. 490. Advanced Composition and Conversation (3)
Sp. 496. Literary Criticism in France, Italy, and Spain (3)

SPEECH

Professor Robert T. Oliver, M.A., Ph.D., LL.D.
Head of the Department

Speech 500. Seminar in American Oratory (2-4) The history of American oratory, with the application of critical standards to the work of specific orators. Prerequisite: 6 credits in speech, including Speech 200. *Professor O'Brien*

SPEECH 505. HISTORICAL DEVELOPMENT OF SPEECH THEORY (2-4) Survey of ancient, medieval, and modern theories of public address in relation to currently accepted speech theories. *Professor DeBoer*

SPEECH 508. SEMINAR IN BRITISH ORATORY (2-4) History of British oratory; application of critical standards to the work of selected orators. *Professor Fife*

SPEECH 510. SEMINAR IN METHODS OF TEACHING SPEECH (2-4) Curriculum construction, media, and methods in high school and college. Prerequisite: 6 credits in speech, including Speech 200. *Professor O'Brien*

SPEECH 520. SEMINAR IN SPEECH SCIENCE (2-4) A seminar in the physical and physiological bases of speech and voice; introduction to the laboratory techniques used in speech research. Prerequisite: 9 credits in speech, speech education, or psychology.

SPEECH 525. SEMINAR IN CLINICAL SPEECH PATHOLOGY (2-4) A physiological, neurological, and psychological view of the speech process together with a critical study of modern theories and practices in clinical speech pathology. Prerequisites: Speech 490, 491. *Professor McDonald*

SPEECH 540. SEMINAR IN THE PROBLEMS OF RADIO (3) Advanced study and research in special problems in radio speech, radio production, and radio organization. Prerequisite: 6 hours of speech, including Speech 200, 300; 425 or 435. *Professor Nelson*

SPEECH 550. SEMINAR IN ORAL PERSUASION (2-4) Theory and devices of persuasion; analysis of persuasive discourse. Prerequisite: 6 credits in speech, including Speech 200.

SPEECH 555. SPEECH COMMUNICATION: PROBLEMS AND PRINCIPLES (2-4) Prevalent theories of speech influence. *Professor Oliver*

SPEECH 560. PUBLIC ADDRESS (2-4) Discussion and criticism of speech outline, manuscript, content, composition, and delivery. Prerequisite: 6 credits in speech, including Speech 200. *Professor Schug*

SPEECH 575. RESEARCH PROBLEMS IN SPEECH (1-12) Advanced research on an individual basis in oratorical criticism, discussion techniques, persuasion, pedagogy, phonetics, speech science, and speech pathology. Prerequisite: 12 credits in speech or in speech education.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

SPEECH 400. TEACHING OF SPEECH (3) *Professor Schug*
SPEECH 401. PROBLEMS, METHODS, AND AREAS IN SPEECH (1) *Professor Carter*
SPEECH 405a,b,cS. PRACTICAL PROBLEMS IN PUBLIC AND PRIVATE SPEECH (1-3)
SPEECH 410. ENGLISH PHONETICS AND PRONUNCIATION (3) *Professor O'Brien*
SPEECH 411a,b,cS. SPEECH SCIENCE AND SPEECH ARTS (1-3)
SPEECH 412. SPEECH COMPOSITION (3) *Professor DeBoer*
SPEECH 415. APPLIED PHONETICS FOR CLINICIANS (3) *Professor Brong*

SPEECH 416. METHODS OF COACHING DEBATE (3)
SPEECH 425. ADVANCED PRINCIPLES OF RADIO SPEECH (3) *Professor Nelson*
SPEECH 431. ANATOMY AND PHYSIOLOGY OF THE EAR AND VOCAL MECHANISMS (3)
SPEECH 435. RADIO ORGANIZATION (3) *Professor Nelson*
SPEECH 437. PRINCIPLES OF TELEVISION SPEECH (3) *Professor Nelson*
SPEECH 445. SPEECH AS A MEDIUM OF INTERNATIONAL RELATIONS (3) *Professor Oliver*
SPEECH 450. DISCUSSION TECHNIQUES (3) *Professor O'Brien*
SPEECH 490. SPEECH DISORDERS AND THEIR TREATMENT (3)
SPEECH 491. CLINICAL SPEECH PRACTICUM (1-3) *Professor Raabe*

SPEECH EDUCATION

Consult PROFESSOR EUGENE T. MCDONALD, M.Ed., D.Ed.

SPEECH ED. 537. ADVANCED SPEECH CORRECTION (1-6) The clinical speech procedures of examination, diagnosis, and treatment. Prerequisite: Speech Ed. 437 or Speech 491.

SPEECH ED. 540. ARTICULATION DISABILITIES (3) Speech-sound production disorders in children and adults; methods of examination, diagnosis, and treatment. Prerequisite: Speech 490 or Speech Ed. 436.

SPEECH ED. 541. THE VOICE AND ITS DISORDERS (3) Physical, physiological, and psychological bases of voice production; causes, nature, and symptoms of its disorders; current clinical methods in voice improvement. Prerequisite: Speech Ed. 436 or Speech 490.

SPEECH ED. 542. STUTTERING AND ALLIED DISORDERS (3) Modern theories of the causes of disorders of rhythm; methods of examination, diagnosis, and treatment. Prerequisite: Speech 490 or Speech Ed. 436.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

SPEECH ED. 430. PROBLEMS OF THE CHILD WITH A HEARING LOSS (3)
SPEECH ED. 434. AUDIOMETRY AND HEARING AIDS (3)
SPEECH ED. 435. CLINICAL PRACTICE WITH THE DEAF AND HARD-OF-HEARING (3)
SPEECH ED. 436. SPEECH DISABILITIES (3)
SPEECH ED. 437. SPEECH CORRECTION (1-3)
SPEECH ED. 439X. FUNDAMENTALS OF SPEECH EDUCATION (3)
SPEECH ED. 439aX. METHODS IN SPEECH EDUCATION (3)
SPEECH ED. 440, 440X. SPEECH EDUCATION AND REEDUCATION IN THE ELEMENTARY SCHOOL (2-3)
SPEECH ED. 441S. CURRENT PROBLEMS IN SPEECH AND HEARING (1-6)
SPEECH ED. 442. SPEECH PATHOLOGY (3)
SPEECH ED. 443. METHODS IN AUDITORY TRAINING AND SPEECH READING (3)

ZOOLOGY

PROFESSOR PENNOYER F. ENGLISH, M.S., Ph.D.
Acting Head of the Department of Zoology and Entomology

ZOOL. 509. TECHNIQUES IN WILDLIFE MANAGEMENT (3) Preparing study mounts, census making, management area mapping, methods of collecting data, and determining food habits from stomach contents. Prerequisite: Zool. 546.
Professor English

ZOOL. 512. SEMINAR (1) The review of current zoological literature. Required of graduate students majoring in zoology and entomology. Prerequisite: 12 credits in zoology or entomology. *Professor English*

ZOOL. 513. RESEARCH (1-15 per semester) The prosecution of an assigned problem under the guidance of an instructor. Prerequisites: Zool. 410, 432, 437, 440 or 546.

ZOOL. 532S. ANIMAL PARASITES (3) Structure, life cycle, and control. Prerequisite: Zool. 432.

ZOOL. 541. COMPARATIVE PHYSIOLOGY (3) The dynamics of vital processes as shown in members of the animal kingdom. Prerequisites: Zool. 25, 26; Agr. Biochem. 1; Agr. Biochem. 425 or Zool. 437. *Professor Frings*

ZOOL. 546. THE THEORY OF GAME MANAGEMENT (4) Fundamental principles underlying the management of wild game birds and mammals; the co-ordination of such management with the various land uses; the planning of preserves and other land areas. Prerequisites: Zool. 408, 420. *Professor English*

ZOOL. 547S. WILDLIFE MANAGEMENT (3) The basic principles concerned with the management of game birds and game mammals. Prerequisites: Zool. 25, 26, 420.
Professor English

ZOOL. 551. FISHERIES MANAGEMENT (3) The basic principles underlying the management of inland waters for fish production. Prerequisite: Zool. 450.

ZOOL. 581. ADVANCED INVERTEBRATE ZOOLOGY (3) The morphology, physiology, taxonomy, and life histories of invertebrate animals. *Professor Frings*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

ZOOL. 408. MAMMOLOGY (4) *Professor English*
ZOOL. 410. GENERAL LIMNOLOGY (3)
ZOOL. 415. THE LITERATURE OF VERTEBRATE ZOOLOGY (1) *Professor Frings*
ZOOL. 416. THE METHODS OF RESEARCH IN ZOOLOGY (2)
ZOOL. 417. INVERTEBRATE FAUNISTICS (4) *Professor Frings*
ZOOL. 418S. FIELD ORNITHOLOGY (3) *Professor Wood*
ZOOL. 419S. GENERAL ANIMAL ECOLOGY (3) *Professor Blackburn*

Zool. 420.	Game Birds (3)	*Professor English*
Zool. 432.	Human Parasitology (3)	*Professor Zeliff*
Zool. 436.	Protozoology (3)	*Professor Zeliff*
Zool. 437.	Histology (4)	*Professor Newman*
Zool. 440.	Embryology (4)	*Professor Newman*
Zool. 444.	Zoological Problems (1-6)	
Zool. 445S.	The Identification of Insects (3)	*Professor Blackburn*
Zool. 448.	Ornithology (3)	*Professor Wood*
Zool. 450.	Ichthyology (4)	

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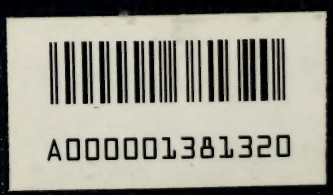
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